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ABSTRACT

A study was conducted to demonstrate the value of a mnemonic strategy in remembering information from prose passages and to assess processing differences associated with three variations of the mnemonic strategy. The subjects were 220 eighth grade students who read four short fictional biographies and answered recall questions that were either randomly ordered or ordered to reflect the way the information was presented in the passages. The students participated as members of the following conditions: (1) two control conditions in which students used their own best methods of remembering the biographical information, (2) a keyword paired condition connecting keyword-stimulus and concrete referents at the sentence level, (3) a keyword-chained condition connecting the keyword and the concrete referents of two sentences, and (4) a keyword-integrated condition that combined the keyword with concrete referents throughout the prose passage. Students in the keyword groups recalled significantly more passage information than did students in the control groups. The likelihood of correctly recalling pieces of information that had been contiguously presented within a passage was found to vary as a function of instructional condition and question order. The experimental groups also differed in terms of the kinds of errors made. Overall, the results suggested the efficacy of using the keyword mnemonic strategy. (RL)

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Technical Report No. 582

THE EFFECT OF MNEMONIC STRATEGY VARIATIONS ON STUDENTS' RECALL OF POTENTIALLY CONFUSABLE PROSE PASSAGES

by

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Report from the Project on
Studies in Language: Reading and Communication

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Chapter 1

Introduction

Mnemonics

At one time, knowledge and use of mnemonic techniques (i.e., methods developed to improve memory performance) was considered tantamount to consorting with the devil, with the likely result of being targeted as an object of interest for the Inquisition (Yates, 1966). Even in the not so distant past, behaviorists scoffed at constructs such as "mental images" as being "mentalistic" and unworthy of scientific scrutiny. Yet, some behavioral scientists have been unwilling to accept the commonly held belief that mnemonics are merely sideshow phenomena, important only as an avenue to a guest appearance on the Tonight Show. In recent years, a great deal of time and effort expended in the careful experimental investigation of mnemonic strategies has resulted in a fairly coherent body of research. A beginning has been made in the delineation of the strengths and limitations of certain mnemonic techniques, as well as toward a rudimentary understanding of the processes and factors influencing the successful utilization of such strategies (Bellezza, 1980; Paivio, 1971). A significant portion of this research has concentrated on the study of visual imagery, typically in conjunction with artificial experimental materials, lacking an inherent structure, such as word lists.

Recently, however, some investigators have demonstrated that a mnemonic technique, called the keyword method, can be successfully applied to real-world tasks. The keyword method was originally conceived as a means of facilitating foreign language learning (Atkinson, 1975). For example, suppose a student wished to learn the English meaning of the Spanish word for letter, carta. The first stage of the keyword method would entail learning the "keyword," an English word that sounds like part of the foreign word. In this example, a suitable keyword for carta might be cart. The second stage of the method would then involve asking the learner to form a visual image that related the keyword to the foreign word's meaning (e.g., a letter in a shopping cart). Students receiving instruction in the keyword method typically recall substantially more definitions than students left to their own devices. This basic mnemonic technique has been adapted to aid not only the learning of English vocabulary (Levin, McCormick, Berry, Miller, & Pressley, in press) but certain social studies curricula as well--the states and their capitals (Levin, Shriberg, Miller, McCormick, & Levin, 1980) and the order of the Presidents of the U.S.A. (Levin, McCormick, & Dretzke, in press). For a complete review of the research conducted on the keyword method, see Pressley, Levin, & Delaney (1980).

From the viewpoint of an educational psychologist, it is especially important to continue in the direction of exploring the relationship of mnemonic strategies to real-world tasks. Specifically, in future research endeavors, an increasing emphasis is needed on

investigating the possible benefits associated with instruction in mnemonic techniques on the recall of information from prose materials. Thus, the present study was designed to illuminate two basic issues regarding the use of mnemonic techniques in prose-learning situations. One purpose of this study was to investigate the potential of the keyword method with regard to expository passages that have been carefully constructed so as to be potentially confusable. The second major purpose of this study was to analyze the component processes of different variations of the keyword method as applied to that task.

Although the effectiveness of mnemonic techniques, such as the keyword method, has been often demonstrated, not much is understood about the manner in which they actually function. Bellezza has suggested that "a mnemonic device can be defined as a strategy for organizing and/or encoding information through the creation and use of cognitive cuing structures" (Bellezza, 1980, ms. p. 37). These cognitive cuing structures, which are comprised of either words or visual images, act as mediators between the stimulus and the to-be-remembered information. Thus, according to Bellezza, the crucial step in using a mnemonic device is to associate the to-be-remembered information with one or more cognitive cuing structures. Moreover, it has been noted (Levin, 1980) that an associative mnemonic strategy involves two components--phonetic recoding and semantic relating. With the keyword method, the cognitive cuing structure that is created can be best described in accordance with these two components. The keyword is associated with the vocabulary word

through an acoustic or phonetic link (phonetic recoding). Then, through an imaginal link, the keyword cues the to-be-remembered translation (semantic relating). Whether or not the organization of cognitive cuing structures vary as a function of the nature of the particular mnemonic strategy variation employed is an important theoretical issue requiring experimental investigation.

Thus, more research is needed, not only to investigate the facilitative effects of mnemonic strategy instructions upon the recall of information from various types of prose materials, but also to shed some light on the manner in which the resultant component processes or "cognitive cuing structures" operate during mnemonic strategy usage.

Chapter 2

Review of the Literature

Mnemonic Strategies and Prose Materials

Relatively few investigators have explored the relationship between instruction in a mnemonic technique and recall of prose information. On the whole, however, the results of these studies have been very promising. Levin and his associates (Shriberg, Levin, McCormick, & Pressley, in press) have developed a prose-learning mnemonic technique based on the keyword method.

In their first experiment, Shriberg et al. presented eighth graders with passages describing the name and accomplishments of fictitious people. The names of these individuals had been drawn randomly from a city phonebook. The first sentence of each passage provided the name of the person and what he or she was famous for (central information). The second and third sentence contained information elaborating on the central idea (incidental details). For example, consider the following passage:

> Animal owners all over the world are impressed that Charlene McKune has taught her pet cat how to count. The cat can count to 20 without making any mistakes. Moreover, the remarkable cat can do some simple addition.

Students in the keyword condition first learned an appropriate keyword for each of the 12 fictitious names, while the control students were equally pre-familiarized with the names. When the stories were presented to the keyword subjects for learning, the first six stories were accompanied by pictures showing the keyword referent interacting with the representation of that person's accomplishment. Thus, for Charlene McKune (keyword = raccoon) who taught her pet cat to count, the keyword subjects saw a picture of a cat counting raccoons (see Figure 1). For the second six stories, the keyword students were not presented with the pictures, but instead were instructed to make up pictures in their heads (i.e., to construct visual images) modeled after those of the first six passages. The control students, on the other hand, were given the same amount of time to use their "own best method" to learn the names and accomplishments.

The results of the experiment were very striking. The keyword groups demonstrated much greater name-accomplishment recall than the control group, both when the pictures were shown to the subjects (over 200% facilitation) and when the subjects were required to generate their own images (over 100% facilitation).

In a second experiment, Shriberg et al. found that a keyword group provided with pictures recalled more name-accomplishment information than a keyword group required to generate all their own images. As in the first experiment, both keyword groups recalled

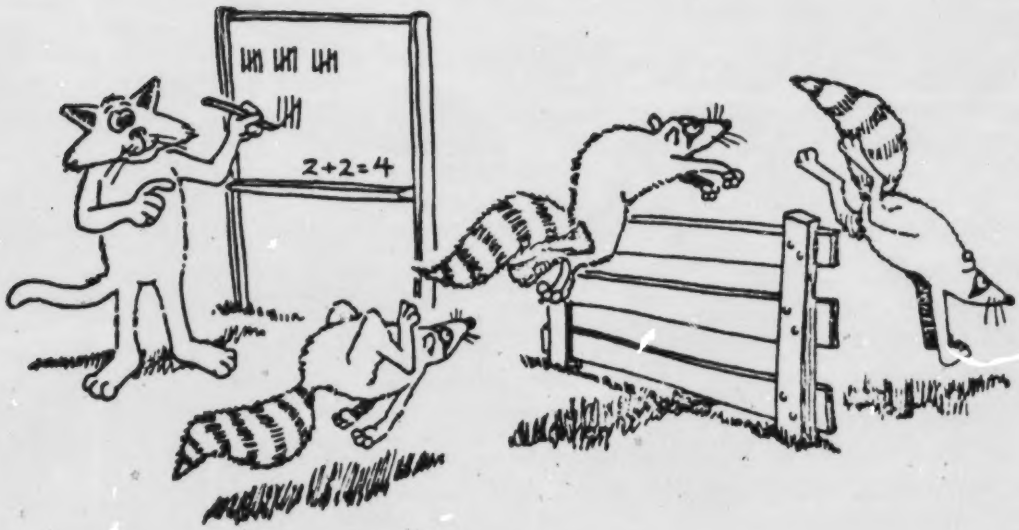

Figure 1. Mnemonic illustration from Shriberg et al. (in press)

significantly more name-accomplishment information than the control group (again, over 200% and 100% facilitation for the picture and imagery conditions, respectively).

In a very recent study, Levin, Shriberg, & Berry (1981) demonstrated that the keyword method was similarly effective with more abstract, less readily pictured prose information. In this study, eighth graders were asked to learn the names of fictional cities and their most salient attributes. For example, the students followed along as the experimenter read:

> Hammondtown has been a much talked-about place lately. It has been making headlines in the news on account of its winning sports teams. In addition to its success on the athletic fields, the town is noted for its atmosphere of warmth and its old-fashioned charm.

Then, the students in the Keyword Condition were shown pictures, such as that in Figure 2, in which a representation of the keyword for the city's name (e.g., ham for Hammondtown) was depicted interacting with representations of that city's salient features. The students who were given an opportunity to study these pictures were better able to match the attributes to the appropriate city than the students who were presented the passage and then shown either: (a) the interactive picture without the keyword; (b) separate pictures of each of the attributes; or (c) a printed list of the attributes. As would be expected from Levin's component analysis of an associative mnemonic strategy, the level of correct clustering of attributes

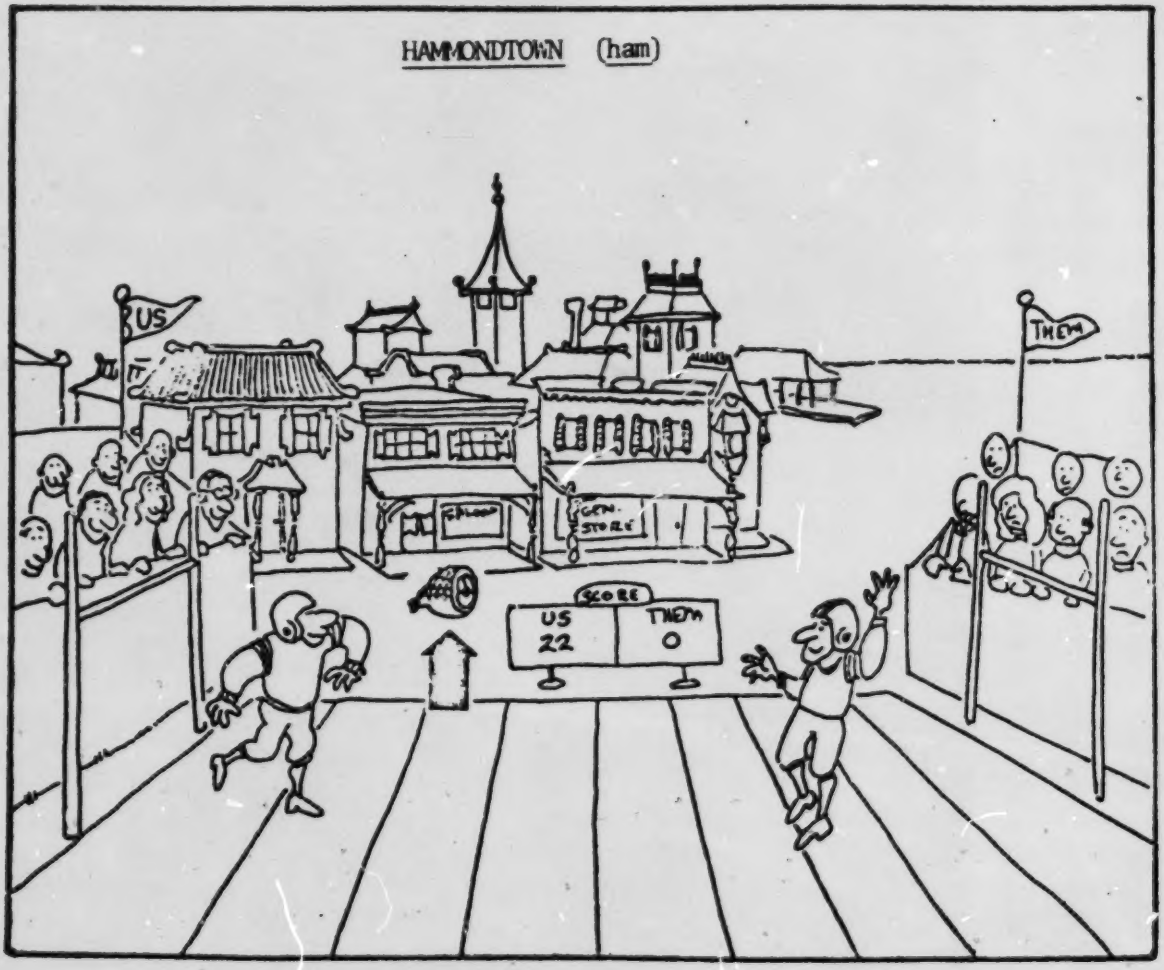

Figure 2. Mnemonic illustration from Levin et al. (1981)

was comparable in the two conditions in which interactive pictures (with or without the keyword) were provided. The students in the keyword condition, however, were better able to pair the attributes with the correct place. Thus, both stages of phonetic recoding and semantic relating are required in an associative mnemonic strategy. Similar results were found in a followup study in which students were required to recall (rather than to match) attributes in response to city names.

Other investigators (e.g., Krebs, Snowman, & Smith, 1978; Snowman, Krebs, & Kelly, 1980) have provided support, albeit somewhat anecdotal, for the contention that instruction in mnemonic techniques can improve the recall of information learned from prose. In the Krebs et al. study, undergraduates who were enrolled in a nine-week course on learning strategies, were trained to analyze prose passages into superordinate central ideas and subordinate information units, to generate corresponding visual images for both types of information, and to incorporate these images into mnemonic loci. Both immediate and delayed recall of passages learned after mnemonic training increased substantially (300% and 840% respectively) over the recall exhibited on a similar passage studied using "typical study methods" (i.e., before mnemonic training). Unfortunately, the absence of a control group and the small sample size (n = 7) makes it difficult to draw meaningful conclusions from these experimental results.

The study by Snowman et al. (1980) utilized a more substantial sample size (n = 96) and manipulated type of strategy instruction in a quasi-experimental design that lacked a control group. Once again, however, students displayed significant prose recall gains after instruction in a mnemonic technique--especially when a mnemonic technique (the method of loci) was combined with instruction in prose analysis. In the method of loci, images of the to-be-remembered information are placed in an orderly arrangement of locations. More anecdotal evidence on the value of mnemonic techniques for the study of prose is available from other sources (e.g., Gruneberg, 1978).

Mnemonic vs. Non-Mnemonic Strategies

On the basis of the preceding discussion, one might be tempted to conclude that provision of pictures or instruction in mental imagery are accountable for great recall gains in a variety of tasks. Some evidence demonstrating that pictures per se are not facilitating (Levin et al., in press; Levin et al., 1981) has been produced in recent research. In the English vocabulary study by Levin et al. (in press), students provided with a pictorial context for each vocabulary word, such as the one for surplus in Figure 3, did not recall more definitions than control students. However, those students provided a picture with an associative "link" via the keyword method, such as the one for surplus in Figure 4, did substantially outperform students in the control condition. Thus, the associative link is a crucial component for a mnemonic strategy.

SURPLUS having some left over, having more than was needed

Figure 3. Contextually explicit nonkeyword illustration from Levin et al. (in press)

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SURPLUS (SYRUP) having some left over, having more than was needed

Figure 4. Contextually explicit keyword illustration from Levin et al. (in press)

This conclusion is also supported by the results of the Levin et al. (1981) prose-learning study described previously in this paper.

For some time, psychologists have felt that instructing students to image the events in a concrete story as they read would help them remember the story content better. There is some truth to this premise. On the whole, however, the effects of such imagery strategy usage are small (see Levin, 1981; and Pressley, 1977; for a review). For instance, in a study conducted by Pressley (1976), when 8-year-olds imaged the text of a concrete story while they read it, they remembered about 21% more information than if they only read the story. The magnitude of this effect seems particularly paltry when compared with the amount of facilitation resulting from the use of the prose-imagery strategy discussed previously (Shriberg et al., in press, Experiments 1 and 2). Thus, it seems that the imagery component of the strategy may not be as crucial as the phonetic recoding (Levin, 1980) component inherent to the keyword method.

In an effort to shed some light on this theoretical issue associated with visual imagery strategy instruction, Levin (1981) has distinguished between two types of prose-learning imagery, representational and transformational. Representational imagery refers to the kind requested when students are simply to represent the content of concrete narrative passages as pictures in their heads. On the other hand, transformational imagery is best characterized by the kind required in the keyword strategy used in

Shriberg et al.'s Experiments 1 and 2. With this strategy, to-be-remembered information (e.g., names and accomplishments) is transformed into a more memorable representation via the incorporation of new information (e.g., keywords interacting with accomplishments). In a third experiment of the Shriberg et al. series, the hypothesis that comparatively greater recall is associated with transformational imagery instruction than with representational imagery instruction was tested.

In this experiment, eighth graders were once again presented fictitious passages about "famous" people and their accomplishments. In this experiment, however, the people's names (e.g., Larry Taylor) were given to half the students, and their occupations (e.g., a tailor) to the other half. All the surnames were selected so that they corresponded to the names of occupations (e.g., Tom Butler vs. a butler; Charlene Fidler vs. a fiddler). For the occupational passages, students in the imagery group were asked to generate images corresponding directly to the passage content (representational imagery), whereas those students in the name passage imagery group first had to convert a name into its acoustically identical occupation (transformational imagery). Students in the two control groups were instructed to use their "own best learning strategy" to remember the various people's accomplishments. The difference in recall between students in the experimental and control groups was significant only for those receiving name passages (and not for those receiving occupation passages). Therefore, the

results of this experiment supported the hypothesis that much greater prose-learning facilitation can be expected from transformational imagery than from representational imagery.

On the basis of the arguments presented so far, it can be concluded, first of all, that mnemonic strategies can be successfully applied to educationally relevant tasks. Furthermore, it has been demonstrated that certain mnemonic strategies, particularly the keyword method, can be adapted for use in the successful recall of information from prose material. The results of the experiments by Shriberg et al. (in press) and Levin et al. (1981) indicate that the effects of a mnemonic imagery technique upon the learning of prose material can be quite large. In fact, the magnitude of these effects is especially impressive when compared to the effects of the typical imagery instructions used for prose learning in the past. A theoretical distinction between two types of imagery instructions, representational versus transformational, has been proposed (Levin, 1981) to help explain the relative effectiveness of mnemonic versus nonmnemonic imagery strategies.

Interference Phenomena

Further consideration of the materials used in the Shriberg et al. (in press) experiments leads to the question of what effect mnemonic strategy instruction might have upon the recall of potentially confusable prose passages. That is, considering the task of associating names and accomplishments required in these studies, it is possible that the students in the control conditions were having

problems associating a particular name with a particular accomplishment due to confusion resulting from exposure to the other name-accomplishment pairs. This situation is analogous to the interference phenomenon (i.e., the detrimental effect of interpolated learning) which has long been of interest to experimental psychologists.

Although the interference effect has traditionally been studied within the framework of a list-learning paradigm (see Postman, 1975, for a review), there is considerable evidence suggesting that similar mechanisms may be operating during the learning of prose materials (e.g., Anderson & Myrow, 1971; Bower, 1974; Crouse, 1971; Kalbaugh & Walls, 1973; Myrow & Anderson, 1972; Thorndyke & Hayes-Roth, 1979). In the typical procedure employed in these experiments, subjects learn and are tested successively on similar prose passages. The passages are usually constructed so as to be maximally interfering. For instance, in many of the studies, the subjects learned biographies having the same basic structure, in which only the exemplars have been varied across passages. One passage is usually designated as the target passage and the effect of learning a number of similar interpolated passages upon subsequent recall of the target passage is measured. Although the presence and size of the interference effect in the learning of prose material fluctuates in relation to the conditions of maximally interfering interpolated passages, number of interpolated passages, and type of test, the interference effect with

prose material has been demonstrated to be as large as a 40% to 60% decrease in recall (Crouse, 1971; Kalbaugh & Walls, 1973) relative to subjects receiving unrelated, non-interfering interpolated passages, or no interpolated passages at all.

Instruction in Mnemonic Strategies and Interference Effects

There is some evidence (Arbuckle, 1971; Bugelski, 1968; Ross & Lawrence, 1968) that typical interference effects are less likely to be present when mnemonic strategies are employed during paired-associate learning. For instance, Bugelski (1968) investigated the effects of a mnemonic technique called the pegword method on the one-trial learning of six 10-item lists. In the pegword method, images of the to-be-remembered information are associated in one-to-one correspondence with images of words that rhyme with the first ten integers (e.g., one for bun, two for shoe, etc.). Subjects using the imagery mnemonic technique displayed uniformly high recall on each list, whereas the pattern of learning of the subjects in the control condition suggested a strong interference effect. Some researchers (Keppel & Zavortink, 1969; Lowry, 1974; Postman & Gray, 1979) have criticized these experiments, in which instruction in a mnemonic technique has been associated with little or no interference effects, since the level of learning was not equated across type of instruction condition. In the study by Keppel and Zavortink (1969), the word lists were studied to the criterion of one perfect recall trial. Those students taught a mnemonic technique learned the lists at a more rapid rate and were also more

resistant to retroactive interference than the control students. Lowry (1974) criticized studies such as Bugelski's (1968) for not equating level of learning, for not exerting proper controls, and for not comparing different types of mnemonic strategies (i.e., verbal vs. imaginal). Lowry's study, however, is difficult to interpret because students in the rote repetition control group were brought to a higher criterion level than were the two mnemonic groups (verbal and imaginal). Furthermore, the presentation rate for the second list was so rapid (1.25 seconds per item) that it would be very difficult to use mnemonics (see Bugelski, Kidd, & Segman, 1968; Paivio, 1971; Rohwer & Ammon, 1968). This extremely rapid presentation rate was clearly a factor in Lowry's study in that the mnemonic groups performed worse on List 2 learning than the control group. Since it is very likely that the mnemonic groups were disturbed by the rapid rate of presentation, the validity of Lowry's conclusion that mnemonic strategy usage does not result in diminished interference effects is in doubt. In another study, Postman and Gray (1979) varied item concreteness in order to determine the influence of item concreteness per se upon susceptibility to interference when "subjects are allowed to develop their own mnemonic strategies." Unfortunately, the two-second presentation rate used in that study likely precluded the utilization of any mnemonic strategy.

Overcoming Interference Effects in Prose

Little research has been conducted demonstrating techniques for overcoming the interference effects which can be found in prose

learning. In the study by Thorndyke and Hayes-Roth (1979), prose interference effects were eliminated by "increasing the discriminability" between competing details instantiating a concept. This increased discriminability was achieved by simply introducing a 24-hour delay between presentation of the "training" and "target" passages. Intuition would suggest that some type of cognitive strategy could also be used to reduce interference effects in successively presented prose passages. For instance, information gathered in a post-experimental questionnaire from a study demonstrating the phenomenon of prose interference effects (Howe & Colley, 1976) indicated that those students who noticed the confusing nature of the to-be-learned prose materials were also more likely to be resistant to interference effects. This suggests, along with some actual student reports, that these students probably "did something" to help them overcome the problem of confusion.

One effective way to combat prose interference effects, as indicated in a study by Royer, Sefkow, & Kropf (1977), is to relate the to-be-learned prose materials to existing knowledge structures (also see Sulin and Dooling, 1974). College students read successive passages labeled with either the names of actual famous people (i.e., Louis Armstrong and George Wallace) or with fictitious names (i.e., Thomas Clark and Homer Hill). In comparison to control groups, students receiving fictitious name initial

passages displayed significant interference effects, whereas students receiving famous name initial passages did not. Thus, it seems possible that instruction in a learning strategy that involves relating to-be-remembered information to some sort of "anchor" may be effective in facilitating the recall of interfering prose materials. In fact, David Ausubel (1963) has long argued against the importance of interference in prose learning as long as "potentially interfering" passages are "meaningfully" related to the existing cognitive structure.

In summary, this brief review of the literature on prose interference effects would suggest that prose-learning mnemonic techniques might prove to be particularly valuable in situations in which the to-be-learned prose materials are potentially confusable. Furthermore, although the size of the interference effect appear to vary from study to study (depending primarily upon the number and nature of the to-be-remembered prose passages), it is not too difficult to imagine situations in which interference effects could be a potent factor in learning the types of prose often encountered during school-learning situations. Thus, determining whether or not mnemonic strategies can combat the deleterious effects of interference in potentially confusable prose materials is an important question for experimental investigation.

Chapter 3

Statement of the Problem

In the previous chapters, evidence had been presented documenting the facilitative effects of mnemonic strategies upon the recall of information from prose materials. Specifically, impressive recall gains have been associated with instruction in a prose-learning imagery mnemonic technique based upon the keyword method. Moreover, as suggested in the review of the research on prose interference effects, it might be particularly fruitful to search for mnemonic facilitation when the to-be-learned prose information is constructed so as to be potentially confusable.

Furthermore, although not much has been discovered about the manner in which mnemonic strategies function, it has been theorized (Bellezza, 1980) that mnemonics are effective due to the creation and use of cognitive cuing structures. In the case of imagery mnemonics, it could be further hypothesized that the structure of the mnemonic image is likely to be reflected in the organization of the resultant cognitive cuing structure. Therefore, it is important to investigate how variations in the organizational structure of the mnemonic image affect the <u>amount</u> and <u>pattern</u> of recall from prose.

These questions were addressed in this study by asking students to learn biographical information contained in successively presented prose passages. These biographies were constructed so as to be potentially confusable. In order to facilitate the successful recall of the particular pieces of biographical information associated with a particular individual, some students were given instruction in the keyword method. Following the approach of Shriberg et al. (in press), keyword students were instructed to associate the keyword corresponding to an individual's name with the accompanying biographical information about that individual. In contast, control students were instructed to use their own study techniques to remember the passage information.

There were several differences between the specific keyword instructions used here and those of Shriberg et al. (in press), however. These changes in procedure were made in view of considerations of ecological validity and economical feasibility of the method.

First of all, since providing appropriate interactive pictures will not always be economically, as well as educationally, feasible, it is important to determine whether keyword instruction will be facilitative when students are told exactly what the interactive relationship should be but are not actually provided with a pictorial depiction of the interaction. This instruction is different from the typical imagery instruction (e.g., Shriberg

et al., in press), in which students are told to image referent A and referent B interacting, but are not told what specific interaction to image. It was hoped that the "structured imagery instructions" used in this study would prove to be of benefit in the recall of information from prose materials.

Secondly, these "structured imagery instructions" were given to groups of students in booklet form, rather than in an individual tutorial session. Although group instruction in the provided picture version of the keyword method had proved to be beneficial in prose learning (Levin et al., 1981), even more support for the ecological validity of the keyword method would be provided by the success of group instruction in the "structured imagery instructions" used in this study.

Finally, due to the theoretical considerations described previously, keyword instructions which varied in terms of the organizational structure of the mnemonic image, were developed for experimental test in this study. It was expected that the cognitive cuing structures created through these variously organized to-be-generated images would result in different amounts and/or patterns of recall of the prose information. As described earlier, the cognitive cuing structure that is created through instruction in the prose-learning version of the keyword method can be described in the following fashion. The keyword is associated to the name through an acoustic or phonetic link. Then, through an imaginal link, the keyword cues the to-be-remembered

information. The organization of these cognitive cuing structures should reflect the organization of the mnemonic image itself. Three different keyword strategy variations were devised for the present study, each with a hypothesized different cognitive cuing structure. These will now be presented. Examples of the nature of the structured imagery instructions for each of the keyword conditions are provided in Table 1.

(1) Keyword-Paired

Students in this condition were instructed to image the keyword referent paired in an interactive image with a concrete referent for each piece of information provided in the biography. See the example provided in Table 1. The organization of the mnemonic images produced via these instructions is best schematized by Figure 5. Thus, the cognitive cuing structure resulting from

Passage One	Passage Two
$KW_1 - O_1$	$KW_2 - O_1$
$KW_1 - O_2$	$KW_2 - O_2$
$KW_1 - O_3$	$KW_2 - O_3$
$KW_1 - O_4$	$KW_2 - O_4$
$KW_1 - O_5$	$KW_2 - O_5$

Figure 5. Keyword-Paired

Table 1

Nature of Structured Imagery in the Various Keyword Conditions

Sentence	Condition: Keyword-Paired	Keyword-Chained	Keyword-Integrated
	"Make up a picture in your head of:"		
1. "While Charlene McKune was growing up, she and her family led an interesting life traveling on their houseboat."	a RACCOON standing on the deck of a houseboat	a RACCOON standing on the deck of a houseboat	a RACCOON standing on the deck of a houseboat
2. "During her school years, McKune earned extra money delivering newspapers."	a RACCOON throwing newspapers onto a doorstep	newspapers being thrown to the shore from the deck of a houseboat	a RACCOON standing on the deck of a houseboat throwing newspapers
3. "McKune was always interested in whatever was happening around her, and so she eventually became a TV news reporter."	a RACCOON being interviewed by a TV reporter	a TV reporter throwing newspapers onto a doorstep	a RACCOON standing on the deck of a houseboat throwing newspapers to a TV reporter on shore

Table 1 (cont.)

Sentence	Condition: Keyword-Paired	Keyword-Chained	Keyword-Integrated
	"Make up a picture in your head of:"		
4. "In her spare time, McKune loves to paint."	a RACCOON painting a picture	a TV reporter painting a picture	a RACCOON standing on the deck of a houseboat throwing newspapers to a TV reporter on shore who is painting a picture
5. "Although McKune is not particularly athletic, she still dreams of some day winning an Olympic gold medal."	a RACCOON with an Olympic gold medal around its neck	an Olympic gold medal hung on a painting	a RACCOON standing on the deck of a houseboat throwing newspapers to a TV reporter on shore who is painting a picture of an Olympic gold medal

these keyword instructions was hypothesized to be best described as a series of separate pairs--not a whole--involving a recurring keyword.

(2) Keyword-Chained

Students in this condition were instructed to image the keyword referent in an interactive image with a concrete referent for the first piece of information provided about that person in the biography. Then the students were instructed to image a referent for the second piece of information interacting with the first, the third with the second, etc. See the example provided in Table 1. Unlike the Keyword-Paired condition, here the keyword is only used once--in the first interactive image. The organization of mnemonic images produced via these instructions is best schematized by Figure 6. Thus, the cognitive cuing structure

Passage One	Passage Two
$KW_1 - O_1$	$KW_2 - O_1$
$O_1 - O_2$	$O_1 - O_2$
$O_2 - O_3$	$O_2 - O_3$
$O_3 - O_4$	$O_3 - O_4$
$O_4 - O_5$	$O_4 - O_5$

Figure 6. Keyword-Chained

produced by the Keyword-Chained instructions was hypothesized to be best described as a series of overlapping images. In this condition, however, it is likely that the recall of any piece of information would be contingent upon the recall of the previous piece of information.

A "chaining" imagery mnemonic method much like this one has been proposed in a set of commercially available materials for learning the order of the U.S. presidents (Lucas, 1978). Unfortunately, the effectiveness of Lucas's "chaining" procedure has never been empirically tested. A verbal "chaining" procedure, however, has proved to be ineffective in a list-learning task (Jensen & Rohwer, 1963; Jensen & Rohwer, 1965). In these studies, the serial recall of both mentally retarded adults (Jensen & Rohwer, 1963) and normal students, ranging from kindergarteners to twelfth graders (Jensen & Rohwer, 1965), was demonstrated to be little affected by verbal mediation instructions. Therefore, although this condition was included primarily because of the variation in the cognitive cuing structure that these "chaining" instructions might produce, empirical assessment of the effectiveness of this "chaining" mnemonic strategy was also considered important.

(3) Keyword-Integrated

Students in this condition, like those in the Keyword-Chained condition, were instructed to image the keyword referent in an interactive image with a concrete referent for the first piece of information provided about that person in the biography. As

each new piece of information was presented, the students were asked to add it to the picture they had already formed in their heads. Thus, all the information contained in each passage was represented in a single interactive image. See the example provided in Table 1.

The images produced by these instructions are not truly analogous to the integrated pictures provided in the Shriberg et al. (in press) and Levin et al. (1981) studies. In those studies, the keyword referent, centrally located in the picture, was depicted interacting with all the other to-be-remembered information. In the imagery instructions for the Keyword-Integrated condition, the keyword referent is not truly "integrated" with all the other pieces of information. Instead, the image is a meaningful, single episode that originates from the keyword referent. The organization of the mnemonic image produced via these instructions is best schematized by Figure 7. The hypothesized cognitive cuing structure produced by the Keyword-Integrated instructions can

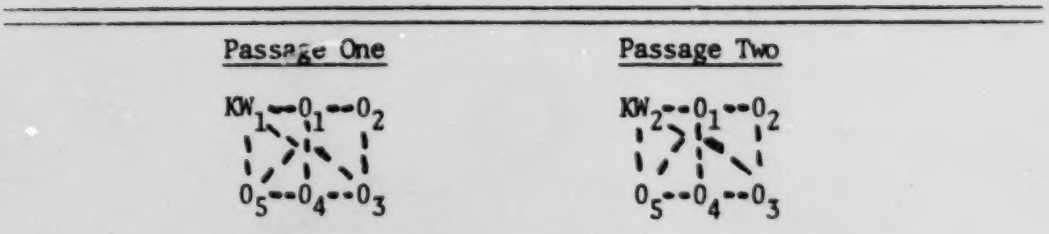

Figure 7. Keyword-Integrated

probably be best likened to a "grand imaginal scene" (Bower, 1972) in which the keyword referent and referents for all the pieces of information are connected via a single interactive image.

Although the imagery instructions in the Keyword-Integrated condition did not completely correspond to the picture version of the keyword method that had proved so successful in previous research, it seemed reasonable to expect that the Keyword-Integrated imagery instructions would be facilitative on the basis of research demonstrating the effectiveness of very similar verbal mediators in serial learning tasks. In this research, it was found that students of various ages exhibited greater serial recall of word lists when provided with an organizing structure (Levin, 1970; Levin & Rohwer, 1968), as well as when instructed to construct their own thematic organization (Bower & Clark, 1969).

The recall performance of these three structured keyword groups was compared to that of two control groups now described.

(4) Simple Control

The students in this group were simply asked "to try hard to use your own best method of studying" to remember each piece of information contained in the biographies. This control group is an appropriate comparison group for the Keyword-Paired and Keyword-Chained conditions because the students in this group were given an opportunity to study each piece of information one at a time. For an example of the study instructions, see Table 2.

Table 2

Nature of Study Instructions for Control Conditions

Sentence	Condition: Simple Control	Condition: Cumulative Control
	"Try hard to remember that:"	
1. "While Charlene McKune was growing up, she and her family led an interesting life traveling on their houseboat."	McKune lived on a houseboat	McKUNE lived on a houseboat
2. "During her school years, McKune earned extra money delivering newspapers."	McKune delivered newspapers	McKUNE lived on a houseboat delivered newspapers
3. "McKune was always interested in whatever was happening around her, and so she eventually became a TV news reporter."	McKune became a TV reporter	McKUNE lived on a houseboat delivered newspapers became a TV reporter

Table 2 (cont.)

Sentence	Condition: Simple Control	Condition: Cumulative Control
	"Try hard to remember that:"	
"In her spare time, McKune loves to paint."	McKune enjoys painting	McKUNE lived on a houseboat delivered newspapers became a TV reporter enjoys painting
"Although McKune is not particularly athletic, she still dreams of someday winning an Olympic gold medal."	McKune would like to win an Olympic gold medal	McKUNE lived on a houseboat delivered newspapers became a TV reporter enjoys painting would like to win an Olympic gold medal

(5) Cumulative Control

This condition was included to control for the repeated exposure to the to-be-remembered information found in the Keyword-Integrated condition. The students in this condition were given study instructions identical to those for the Simple Control group except, as in the Keyword-Integrated condition, with each new piece of information presented the previous information was repeated. For an example, see Table 2.

In an attempt to delineate differences in the recall produced by the various experimental instructions, students in each instruction condition were assigned to one of two question conditions, ordered and unordered. In the Ordered question condition, all the questions referring to a particular passage were successively presented in the same order in which the information originally appeared in the biography. In the Random question condition, the questions for all the passages were presented in a randomly determined order.

Hypotheses

In terms of the number of details correctly recalled, it was predicted that the recall performance of students in all three keyword groups would be better than that of the appropriate control group, regardless of question condition. Thus, all three keyword-versus-control comparisons were directional. However, no reasonable prediction could be made in terms of overall performance differences among the three keyword conditions and the two control conditions. Thus, these four comparisons were non-directional.

Furthermore, with respect to this measure of total amount of recall, it was anticipated that interaction effects between instruction condition and question order would possibly be present. In particular, when the same seven comparisons used in the analysis of main effects were performed, it was anticipated that the Keyword-Chained condition, in comparison to its control, would be more affected by question order. Specifically, whatever facilitation was observed under the ordered question condition was expected to be greatly diminished under the random question condition. This prediction was based on the overlapping, dependent nature of the cognitive cuing structure hypothesized in the Keyword-Chained condition.

It was also anticipated that the experimental groups would differ in terms of the pattern of recall. The pattern of recall refers to the nature and organization of information recalled. Specifically, it was expected that the patterns of recall in the keyword conditions, in which a "wholistic" or "connected" cognitive cuing structure had been hypothesized (Keyword-Integrated, Keyword-Chained), would exhibit greater within-passage sequential dependencies than in the other conditions. Within-passage sequential dependencies, or the likelihood of recalling pieces of information that had been contiguously presented, were also expected to vary across question order. Thus, the following predictions were made. First, dependency effects (defined by differences in conditional probabilities of correct responses) were anticipated for students

in the Keyword-Integrated condition under both question orders. Second, dependency effects were predicted in the Keyword-Chained condition only when the question order complemented the hypothesized cognitive cuing structure (ordered question condition).

Finally, it was anticipated that the experimental groups would differ in terms of the kinds of errors they made. Specifically, in comparison to the appropriate control conditions, students in the keyword conditions should be less likely to confuse information from other passages with that requested. Consequently, a relatively greater proportion of their overt errors should be represented by within-passage intrusions. No reasonable predictions, in terms of pattern differences in overt errors, could be made among the three keyword conditions.

In summary, then it was hypothesized that instructional condition would affect both the quantitative and qualitative nature of recall of the information from the prose passages, and that these effects would be moderated by question order.

Chapter 4

Method

Subjects

Students in eleven eighth-grade classes were subjects in this experiment. Two different middle schools in a midwestern community provided the classes. One middle school provided eight of the classes, whereas the three other classes were from a neighboring middle school serving a very similar socio-economic area in the community. Half of the eight classes at the one school were randomly assigned to the ordered question condition and the other half of these classes were assigned to the random question condition. At the other school, one class was randomly assigned to the ordered question condition, and another class was randomly assigned to the random question condition. The remaining class at this school was assigned to the ordered question condition because the larger classes had ended up in the random question condition. Students within each classroom were randomly assigned to one of the five instructional conditions.

The protocols from seventeen students displaying various behavioral problems were discarded. This subject attrition, although more heavily concentrated in the classrooms in the ordered question condition, was fairly evenly distributed across instructional

conditions. Furthermore, in order to achieve equality in sample size across conditions, the data from nine more subjects were randomly eliminated. The remaining two hundred and twenty students (n = 22) provided the data used in the analysis.

Design and Materials

There were three keyword and two control conditions in this study. The three keyword groups differed in terms of the organization of the mnemonic images produced by the keyword instructions. (1) Keyword-Paired. The students in this condition were instructed to image the keyword referent paired in an interactive image with a concrete referent for each piece of information provided in a biography. (2) Keyword-Chained. Students in this condition were instructed to image the keyword referent in an interactive image with a concrete referent for the first piece of information provided about that person in the biography. Then, the students were instructed to image the second piece of information interacting with the first, the third with the second, and so on. (3) Keyword-Integrated. Students in this condition were instructed to image the keyword referent in an interactive image with the first piece of information. As each new piece of information was presented, the students were asked to add it to the picture they had already formed in their heads.

Students in the two control groups were simply asked "to try hard to use your own best method of studying" to remember the information contained in the biographies. The control groups

differed only in terms of the manner in which the information was presented for study. In the (4) Simple Control group, each piece of information was studied one-at-a-time, whereas in the (5) Cumulative Control group, the previously presented information was repeated with each new piece of information.

Four biographies of fictitious people were specially constructed so as to be mutually confusing. These biographies resembled those used in the prose interference research (e.g., Crouse, 1971) in that the basic structure of the biographies was identical, with only the particular examplars of the structure changing from biography to biography. Each biography contained five pieces of concrete, easy-to-image, information. One piece of information was provided in each sentence. The four fictitious names assigned to these passages were randomly selected from those used in the Shriberg et al. (in press) study. These names, which originally were randomly selected from a city phonebook, were employed in this study because the effectiveness of their associated keywords had already been demonstrated. Each name was randomly assigned to one of the prose biographies. The fictional biographies used in this study are provided in Appendix A. In addition, a sample biography containing three pieces of information was constructed for use in illustrating the instructions for each experimental condition.

Written instructions, study booklets, and test booklets were constructed for each condition. The instructions for each group

were approximately equal in length. Because the teachers involved were not confident about their students' reading skills, the instructions were written at the sixth grade reading level as determined by the Dale-Chall readability formula (Dale & Chall, 1948). The to-be-learned passages were presented in the study booklets. Each sentence was typed on a single page of the booklet. Furthermore, an instruction page followed each page of the biographies. On this page, the keyword subjects were told exactly what to image in order to remember the information from the previous page. For the control students, the to-be-remembered information was repeated (either simply or cumulatively, depending upon condition) on this page. See Appendix A for the instruction pages presented with each biography. Each test question was typed on a single page of the test booklet. A blank space was provided for the students to write their responses. More detailed information on these instructions and booklets will be provided in the following section.

Procedure

The experimental treatments were administered by two experimenters in the intact classrooms during the regular class hour. Each student received the written instructions, study booklet, and test booklet appropriate to his/her assigned condition. All the conditions were represented within each classroom even though all students within the same classroom received only one of the two question orders. Students read the instructions on their own

but were paced through the study and test booklets. This pacing was accomplished by one experimenter (primary experimenter) reading each page of the booklets aloud, while the other experimenter (secondary experimenter) timed and signaled when to continue. The teachers' and author's concern about the students' ability to read the experimental materials led to the oral accompaniment of the printed passages. Because some of the participating classes were meeting at the same time, two different primary experimenters were required. Furthermore, due to other scheduling difficulties, the services of three different secondary experimenters (to time and help hand out booklets) were required to complete data collection.

A detailed description of the instructions for each experimental condition will be presented following an overview of the general procedure.

Overview of the procedure. In the beginning of the written instructions, the students were informed that they would be reading "several stories about make believe people and important information about their lives." The instructions appropriate for each condition were then detailed. The sample biography was used to illustrate implementation of these instructions. Furthermore, in the directions, the students were given a few examples of the types of questions they would be asked later. During the time the students were reading the instructions, they were allowed--in fact, encouraged--to raise their hands to call the experimenter

to their desk if any portion(s) of the directions required clarification. After all students had finished reading the instructions, the experimenter began to read the first of the four biographies, while the students followed along in the study booklets.

Each biography was prefaced by a name page on which was typed the name of the person whose life would be recounted in the following biography. For keyword subjects, the keyword associated with the name was also typed on this page (in parentheses, below the name). The name was presented by the primary experimenter saying "This story is about someone named _____". The students were given 5 seconds to study this name page before the procedure was continued by the primary experimenter instructing the students to "turn to the next page."

Every page of all biographies presented one piece of concrete information in a single sentence. As stated previously (and as may be seen from Appendix A), the basic structure of these biographies was identical, although the pieces of concrete information differed across passages. Following each page of each biography was an instruction page on which was typed either: (1) explicit imagery instructions (all keyword groups); (2) repetition of the important piece of information (Simple Control); or (3) cumulative repetition of all previously presented important pieces of information (Cumulative Control). Progress through the biographies was experimenter paced. The primary experimenter

read each sentence, paused for a few seconds, and then instructed the students to turn to the next page. The students were allowed 20 seconds to read and follow the directions on the instruction page before being directed to turn to the next page. This procedure continued for all four biographies.

Once all four biographies had been studied, the students were asked twenty short-answer questions. After each question was read aloud by the primary experimenter, the students were given 20 seconds to write down their answers before being asked to "turn to the next page". The responses required by these questions were all twenty pieces of information (4 names x 5 attributes) presented in the four biographies. The organization of the question presentation was either ordered or random, depending upon assigned question condition. In the ordered question condition, all the questions referring to a particular passage were successively presented according to the presentation order of the information in the passage. The order of these "question blocks" was randomly determined, with the constraint that the passages were never questioned in the same position that they occupied during study. In the random question condition, the order of the twenty short-answer questions was randomly determined.

Details of the procedure. The following is a description of the instruction booklets read by the students in the keyword and control conditions. The complete instructions for all five instruction conditions are provided in Appendix A.

Students in the keyword conditions were told that they would be reading "several stories about make believe people and important information about their lives". The keyword students were further informed that they would be shown a "special way" to help them remember the important parts of each person's life. Then, use of the keyword technique was illustrated using the short sample biography. The keyword students were told to learn a "word clue" for the last name of the person they would be learning about. This "word clue" was described as a word that sounds something like the person's last name but that is much easier to picture. The nature of a "word clue" was demonstrated through the sample biography. The sample biography was about someone named James Bernard and St. Bernard (i.e., the dog) was given as the "word clue" for James Bernard's last name.

Then, the students were informed that after each sentence of a biography was read, to help remember each important part of the person's life, they would be asked to "make up a picture in your head" of the word clue "doing something". Then, examples of the types of imagery instructions were provided for the three pieces of information contained in the sample biography. The exact instructions for generating mnemonic images differed, in terms of the organization of the image, across the keyword groups.

For instance, for the sentence "When James Bernard was a young man, he fell in a freak accident and broke both legs.", all

keyword students were directed to make up a picture in which the word clue was hooked onto the main information in the sentence, as in the instructions:

> *Make up a picture in your head of:
> a St. Bernard with broken legs in casts

Then, a depiction of what the "picture in your head might have looked" like was provided, as in Figure 8.

The second sentence was: "Not too long after that, Bernard's house was completely destroyed by a tornado." and the imagery instructions provided differed across the three keyword groups. The students in the Keyword-Paired condition were instructed to make up a picture in which the word clue was hooked onto the main information in the sentence, as in the instructions:

> *Make up a picture in your head of:
> a St. Bernard looking over his shoulder at a tornado

A depiction of what the picture might have looked like was presented, as in Figure 9. On the other hand, the students in the Keyword-Chained condition were told to make up a new picture in which the main information of the first sentence was hooked onto the new information, as in the instructions:

Figure 8. Sample mnemonic image (first sentence--all conditions)

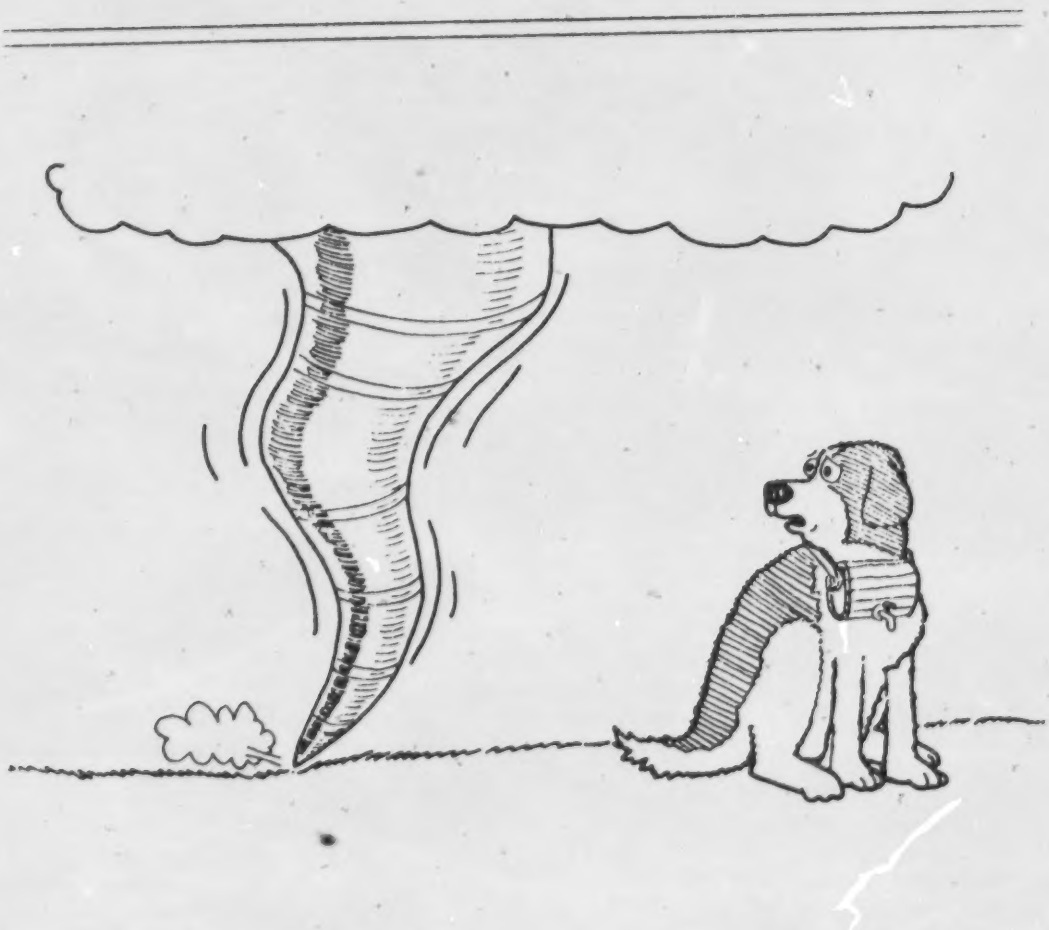

Figure 9. Sample mnemonic image (second sentence/keyword-paired)

*Make up a picture in your head of:

broken legs, in casts, poking out of the top of a tornado

The students were provided with a depiction of what the picture might have looked like, as in Figure 10. The students in the Keyword-Integrated condition were told to hook the main information from this second sentence onto the other information already in their picture, as in the following instructions:

*Make up a picture in your head of:

a St. Bernard with broken legs in casts looking over his shoulder at a tornado

As in the other conditions, a depiction of what this "picture in your head might look like" was provided, as in Figure 11.

Finally, for the last sentence in the sample biography, the students in the Keyword-Paired condition were told to "follow the directions to hook the word clue onto the new information", whereas those in the Keyword-Chained condition were told to "follow directions to hook the main information of the last sentence onto the new information", and those in the Keyword-Integrated condition were told to "follow the directions to hook the main information from the last sentence onto the picture already in your head". Thus, for the sentence "Just recently Bernard began to hope that

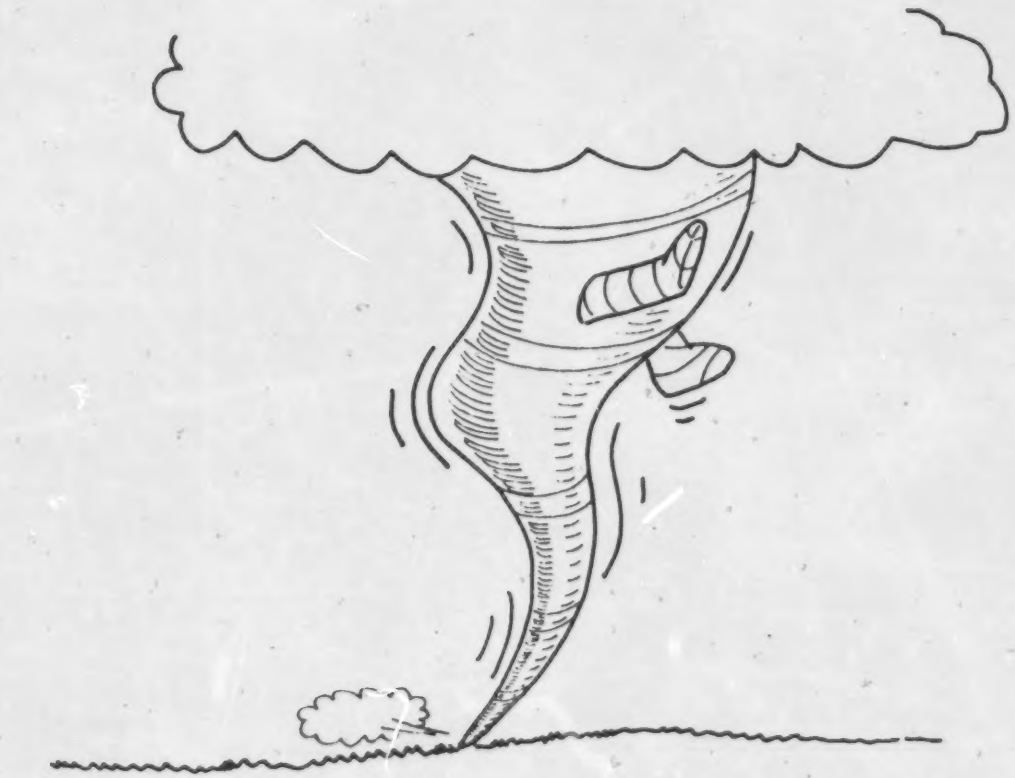

Figure 10. Sample mnemonic image (second sentence/keyword-chained)

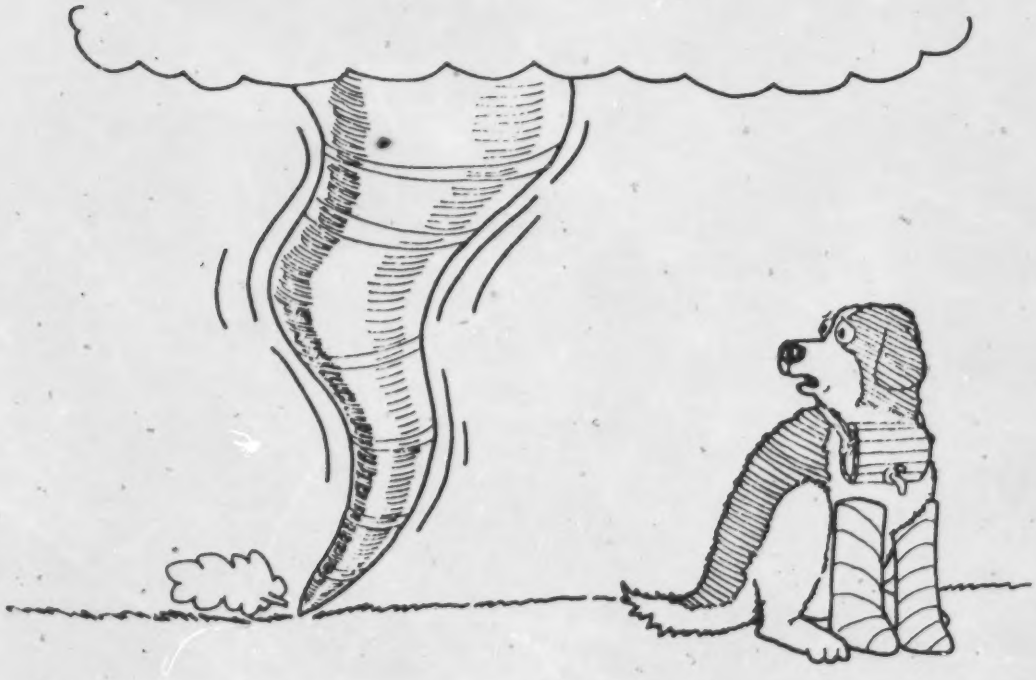

Figure 11. Sample mnemonic image (second sentence/keyword-integrated)

his luck had finally changed when he won a 10-speed bicycle in a raffle.", the specific imagery instructions provided for each of the three keyword conditions were as follows:

Keyword-Paired

*Make up a picture in your head of:

a St. Bernard riding a bicycle

Keyword-Chained

*Make up a picture in your head of:

a tornado chasing after someone riding a bicycle

Keyword-Integrated

*Make up a picture in your head of:

a St. Bernard with broken legs in casts looking over his shoulder at a tornado and hopping on a bicycle

The students in all keyword conditions were told that after all the stories had been read (and after they had made up pictures in their heads, as directed) they would be given a chance to answer some questions about each person. The students were informed that the pictures "you made up in your head should help

you to answer these questions". A description of how these images might help recall the information was provided for the sample question, "What happened to James BERNARD's house?"

The Keyword-Paired students were told that "the name BERNARD would make you think of the word clue St. Bernard which, in turn, would help you remember the picture you made up in your head of a St. Bernard looking over his shoulder at a tornado. So, the answer to the question is that James Bernard's house was destroyed by a tornado."

Those students in the Keyword-Chained condition were told that "the name BERNARD would make you think of the word clue St. Bernard which would help you remember the picture you made up in your head of a St. Bernard with broken legs and the broken legs would, in turn, help you remember the picture of the casts sticking out of a tornado. So, the answer to the question is that James Bernard's house was destroyed by a tornado."

In the Keyword-Integrated condition, the students were told that "the name BERNARD would make you think of the word clue St. Bernard which, in turn, would help you remember the picture you made up in your head of a St. Bernard with broken legs looking over his shoulder at a tornado. So, the answer to the question is that James Bernard's house was destroyed by a tornado."

The students were asked to use the particular imagery technique described for all four to-be-learned biographies. The

students were informed that after all the sentences had been read, they would be asked questions about each person. They were further instructed to use the pictures "you made up in your head to help you answer the questions."

Control students, like the keyword students, were told that they would be reading "several stories about make believe people and important information about their lives." The control students were also informed that they would be provided with a separate listing of the important information and would be instructed to "try hard to remember" these important parts of each person's life. The students were then told that the first step to remember the important information would be to become familiar with the person's name. The manner in which the names would be presented on the name page in the study booklet was demonstrated for the sample biography of James Bernard.

Then, the students were informed that after each sentence of a biography was read, they would be asked to "try hard and use your own best method of studying to help you remember each important part of the person's life." The students in the simple control condition were told that after each sentence was read, they would be instructed to turn to the next page and asked to try hard to remember the main information printed there. This procedure was demonstrated for the three pieces of information contained in the sample passage. Thus, after the first sentence, the students were told to use their "own best method of studying" to:

*Try hard to remember that:

James Bernard broke his legs

For the second sentence, they were told to:

*Try hard to remember that:

James Bernard lost his house in a tornado

and for the last sentence, they were directed to:

*Try hard to remember that:

James Bernard won a bicycle

The instructions for students in the Cumulative Control condition were very similar to the Simple Control instructions, except that students in this condition were told to use their "own best method of studying" to try hard to remember the main information from all previously presented sentences. Thus, for the second sentence, they were instructed to:

*Try hard to remember that:

James Bernard broke his legs
lost his house in a tornado

and for the third sentence, they were directed to:

> *Try hard to remember that:
>
> James Bernard broke his legs
> lost his house in a tornado
> won a bicycle

The students in both control conditions were told that after all the stories had been read (and they had "tried hard" to remember the information), they would be given a chance to answer some questions about each person. The students were informed that whatever they did to study the information should help them answer the questions. The students were then given an opportunity to practice this method in answering the sample question "What happened to James Bernard's house?"

To summarize, in all experimental conditions the students were given an opportunity to study each person's name (and associated keyword, in the keyword conditions) before each passage was read. Then, each passage sentence was read aloud to the students. On the instruction page following each passage page, the students were given either: (1) specific imagery instructions (all keyword groups); or (2) instructions to try hard to remember the repeated information (control groups).

After all four biographical passages had been read and studied, the students were asked to answer twenty short-answer questions

presented (either randomly or in the ordered fashion) in the test booklets. The following types of questions were asked: "Where did _____ live while he/she was growing up?", "What did _____ do to earn extra money while in school?", "What does _____ do for a living?", "What does _____ do in his/her spare time?", and "What does _____ dream of doing?". The students were instructed not to be concerned with spelling, and were encouraged to guess if uncertain about an answer. Testing was experimenter-paced, and students were not allowed to turn back or look ahead in the test booklet. The entire experimental procedure took approximately 40 minutes.

Chapter 5

Results

The data were scored (by the author) "blindly" with respect to experimental conditions. This "blind" scoring was accomplished by tearing off the cover sheet of the test booklet on which was printed the code designating experimental condition. For the most part, the responses were clearly right or wrong, but half-point credit was given for a few isolated responses. (Refer to Table 3 for the responses given partial credit.) The number and nature of overt errors were also noted.

Level of Recall

The mean total recall for each condition is provided in Table 4. Since the two question conditions were not randomized within each classroom but instead whole classrooms were randomly assigned to the question conditions, it was considered inappropriate to make comparisons between question conditions. The main effect of instruction condition upon total recall performance was tested via seven planned pairwise comparisons. Each of these comparisons, based on 210 error degrees of freedom, was performed with $\alpha = .01$ to control experimentwise Type I error rate (at $\leq .07$). Since it could be reasonably hypothesized that keyword instructions would result in a higher level of recall performance than control

Table 3

Responses Given Partial Credit

"lawyer"	instead of judge
"being an athlete"	instead of winning an olympic gold medal
"being an astronaut"	instead of going to the moon
"navy man"	instead of soldier

Table 4

Mean Total Recall for Each Condition

	Keyword-Paired	Keyword-Chained	Keyword-Integrated	Simple Control	Cumulative Control
Ordered Question Condition	$\bar{X}$=12.3409 SD= 4.3899	$\bar{X}$=13.4091 SD= 4.8981	$\bar{X}$=13.4545 SD= 5.4202	$\bar{X}$=10.5682 SD= 4.8533	$\bar{X}$= 9.3636 SD= 5.2603
Random Question Condition	$\bar{X}$=11.2727 SD= 3.3691	$\bar{X}$=10.8182 SD= 4.2047	$\bar{X}$=12.8182 SD= 4.4254	$\bar{X}$= 8.0455 SD= 4.9157	$\bar{X}$=10.1364 SD= 5.3745
Grand Mean	$\bar{X}_P$=11.8068	$\bar{X}_C$=12.1137	$\bar{X}_I$=13.1364	$\bar{X}_{SC}$ =9.3069	$\bar{X}_{CC}$=9.7500

MS_E = 22.5531

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instructions, the three pairwise comparisons of each keyword group with its appropriate control were directional. All three comparisons, the Keyword-Paired group versus the Simple Control group, the Keyword-Chained group versus the Simple Control group, and the Keyword-Integrated group versus the Cumulative Control group, were significant with ts of 2.47, 2.77, and 3.35, respectively. The four remaining nondirectional comparisons of each keyword group with each other (Keyword-Integrated versus Keyword-Paired, Keyword-Chained versus Keyword-Integrated, and Keyword-Chained versus Keyword-Paired) and the two control groups with each other, were all nonsignificant. The ts were all less than 1.33 in absolute value. Therefore, the students in all keyword conditions recalled significantly more passage information than their appropriate controls. The mean recall performance levels of these keyword groups were not, however, significantly different from each other. Furthermore, mean recall performance did not differ in the two control groups.

An effect size measure was computed for the keyword versus control group comparisons, using as an index, $\hat{\Psi}_{\sigma} = (\bar{X}_K - \bar{X}_C) / \sqrt{MS_E}$, or the estimated difference in means expressed in within-group standard deviation units (Levin, 1975). The value of $\hat{\Psi}_{\sigma}$ for Keyword-Integrated versus Cumulative Control was .71; for Keyword-Chained versus Simple Control, .59; and for Keyword-Paired versus Simple Control, .53. Thus, all keyword groups differed from their respective controls by at least half a standard deviation.

Then, the data were analyzed to assess if any interaction effects between instruction condition and question order were present. The seven nondirectional comparisons were all performed at the .01 alpha level. None of these tests for interaction was significant, with all ts less than 1.63 in absolute value.

Patterns of Recall

Supplementary analyses of the data were conducted in order to determine whether the recall of the experimental groups differed qualitatively as well as quantitatively.

Within-passage sequential dependencies. First, for each subject in every condition, the conditional probability of a correct answer following another correct answer within a passage was computed. In this procedure, correct answers following a correct answer within the same passage were assigned the value of "1". Incorrect responses following a correct answer within the same passage were assigned the value of "0". The first correct response in each passage was not scored. Then, for every subject, the number of "1's" and "0's" were tallied, and the proportion of "1's" was computed.

Secondly, the conditional probability of a correct response following an incorrect response was computed for each subject in every condition. The procedure for this computation paralleled the procedure described previously except correct answers following an incorrect answer were assigned the value of "1" and incorrect responses following an incorrect response were assigned the value

of "0". Finally, the difference between these two conditional probability scores (correct given correct minus correct given incorrect) was determined for each subject. Larger differences are indicative of greater within-passage sequential dependencies in the kind of information recalled. In computing these difference scores, the data from some subjects, who either gave all correct responses or whose only errors were "last-question" errors, were disregarded since none of their responses would be assigned a "0" and, therefore, their data are uninformative with respect to the measure desired. See Table 5 for the distribution of both types of disregarded response patterns across experimental conditions. Since the response patterns of these subjects exhibited sequential dependencies and since, according to Table 5, these students were more likely to have been in a keyword condition than a control condition, the difference measure used in the sequential dependency analysis was actually a rather conservative measure of pattern differences in the keyword and control conditions.

The mean conditional probability difference was computed for each question and instruction condition (see Table 6 for the mean conditional probabilities and the mean conditional probability differences). Tests were performed to assess whether any of these mean differences differed significantly from zero. Since it was hypothesized that patterns of recall would vary between the two different question orders, the data from the two question orders were analyzed separately. All tests were performed with $\alpha = .01$.

Table 5

Distribution of Subjects Exhibiting Patterns of Recall Disregarded in the Sequential Dependency Analysis

	Keyword-Paired	Keyword-Chained	Keyword-Integrated	Simple Control	Cumulative Control
Ordered Question Condition					
Number of Subjects With All Correct Responses	1	4	3	0	1
Number of Subjects With Only Last Question Errors	1	0	2	0	0
Random Question Condition					
Number of Subjects With All Correct Responses	1	1	1	1	1
Number of Subjects With Only Last Question Errors	0	0	3	0	1

Table 6

Means of the Conditional Probabilities and Mean Conditional Probabilities Differences for Each Condition

	Keyword-Paired	Keyword-Chained	Keyword-Integrated	Simple Control	Cumulative Control
Ordered Question Condition					
Correct given Correct	0.5792 (0.6118)[a]	0.6605 (0.7222)	0.6760 (0.7411)	0.5337 (0.5337)	0.4822 (0.5058)
Correct given Incorrect	0.4339	0.2654	0.3967	0.4352	0.3733
Difference	0.1453	0.3951	0.2793	0.0985	0.1089
S.D.	0.3452	0.3094	0.3075	0.2409	0.3396
Sample Size	20	18	17	22	21
MS_E = 0.0960					
Random Question Condition					
Correct given Correct	0.4796 (0.5032)	0.4992 (0.5220)	0.5355 (0.6115)	0.3192 (0.3501)	0.3917 (0.4413)
Correct given Incorrect	0.5153	0.3580	0.3131	0.3407	0.3992
Difference	-0.0357	0.1412	0.2224	-0.0214	-0.0075
S.D.	0.2737	0.3331	0.3802	0.2430	0.2771
Sample Size	21	21	18	21	20
MS_E = 0.0918					

[a]Mean Conditional Probability of Correct Given Correct for All Subjects in That Condition

In Table 6 the mean conditional probability of a correct answer following another correct answer, including the data of the subjects disregarded in the mean conditional probability difference analysis, are also provided in parentheses.

In the ordered question condition, the mean difference in conditional probabilities for both the Keyword-Integrated and Keyword-Chained instruction conditions were significantly different from zero. The ts (df=93) were equal to 3.72 and 5.41, respectively. In the three other instruction conditions, Keyword-Paired, Simple Control, and Cumulative Control, the mean differences were not significantly different from zero with ts (93) of 2.10, 1.49, and 1.61, respectively.

On the other hand, in the random question condition, only the mean difference of conditional probabilities for the Keyword-Integrated group was significantly different than zero, with t (96) = 3.11. In the other instruction conditions, Keyword-Chained, Keyword-Paired, Simple Control, and Cumulative Control, the mean differences did not differ from zero. The ts (96) were 2.14, -0.54, -0.32, and -0.11, respectively.

Therefore, as expected, there were qualitative differences in recall depending upon instructional condition. Furthermore, unlike the quantitative analysis in which the recall performance of the keyword groups were only differentiated from that of the appropriate control group, in this qualitative analysis of the mean difference in conditional probabilities, the recall patterns

of the keyword groups could be distinguished from one another. That is, in the ordered question condition, the Keyword-Integrated and Keyword-Chained groups exhibited "clustered" recall, whereas the Keyword-Paired group did not. Furthermore, in the random question condition, only the Keyword-Integrated group exhibited this "clustered" recall.

Nature of overt errors. In another supplementary analysis, the nature of the overt errors made by the students in each condition was noted. In this analysis, each intrusion was categorized as to whether it was a correct response for another question from the same story, or a same-story error (e.g., Charlene McKune paints for a living), the correct response for that same question from a different story, or a same-attribute error (e.g., Charlene McKune is a firefighter), or something else (e.g., from a different question and different passage or a "guess" from prior knowledge). Then, for each subject, the frequency of each type of intrusion (Same Story, Same Attribute, and Other) was tallied and the proportion of each type of intrusion relative to the total number of intrusions was computed. Then, the mean proportion of each type of intrusion was computed for each question and instruction condition. (See Table 7 for the mean proportion of each type of intrusion.) Planned pairwise comparisons were performed on the data in order to determine if instruction groups differ in terms of the intrusions made during recall. Since it was hypothesized that recall intrusions may vary across the question

Table 7

Mean Proportion of Same Story and Same Attribute Intrusions for Each Condition

	Keyword-Paired	Keyword-Chained	Keyword-Integrated	Simple Control	Cumulative Control
Ordered Question Condition					
Same Story					
	0.2163	0.1229	0.2024	0.0375	0.0089
	(n=15)	(n=16)	(n=18)	(n=20)	(n=20)
MS_E = 0.0585					
Same Attribute					
	0.4116	0.7115	0.4861	0.8187	0.7491
	(n=15)	(n=16)	(n=18)	(n=20)	(n=20)
MS_E = 0.1293					
Random Question Condition					
Same Story					
	0.3899	0.3816	0.6231	0.1233	0.0663
	(n=20)	(n=21)	(n=20)	(n=20)	(n=18)
MS_E = 0.0762					
Same Attribute					
	0.4143	0.5274	0.2878	0.6965	0.8001
	(n=20)	(n=21)	(n=20)	(n=20)	(n=18)
MS_E = 0.1082					

orders, the data for the two question orders were analyzed separately. All tests were performed with $\alpha = .01$.

Since it could be reasonably hypothesized that keyword instructions would result in a higher proportion of Same Story intrusions, all comparisons of the proportion of Same Story intrusions of a Keyword group with its appropriate Control were directional. In the ordered question condition, only the students in the Keyword-Integrated group exhibited a higher proportion of Same Story intrusions than their appropriate control group, with t (84) = 2.46. All other pairwise comparisons were non-significant, all ts < 2.16.

On the other hand, in the random question condition, all three keyword groups (Keyword-Paired, Keyword-Chained, and Keyword-Integrated) produced a higher proportion of Same Story intrusions than their control counterparts, with ts (94) of 3.05, 3.00, and 6.21, respectively. Moreover, nondirectional pairwise comparisons indicated that students in the Keyword-Integrated condition committed a higher proportion of Same Story intrusions than students in both the Keyword-Paired and Keyword-Chained conditions, with ts (94) of 2.67 and 2.80, respectively. Comparisons of Same Story intrusions made in the Simple Control versus Cumulative Control condition and in the Keyword-Paired versus Keyword-Chained condition yielded negligible ts.

Since it could be reasonably hypothesized that keyword instructions would result in lower proportion of Same Attribute

intrusions, all comparisons of the proportion of Same Attribute intrusions of a keyword group with its appropriate control were directional. In the ordered question condition, only the students in the Keyword-Paired condition made a lower proportion of same attribute errors than their control counterparts, t (84) = 3.32. All other pairwise comparisons were nonsignificant, all ts < 2.39. On the other hand, in the random question condition, students in both the Keyword-Paired and Keyword-Integrated conditions made relatively fewer Same Attribute intrusions than their control counterparts, with ts (94) of 2.71 and 4.79, respectively. All other pairwise comparisons were nonsignificant, all ts < 2.33.

Chapter 6

Discussion and Implications

The purposes of this study were two-fold. First, it was considered important to demonstrate that a prose-learning mnemonic strategy would facilitate students' recall of information from potentially confusable prose passages. Secondly, the study was designed to assess processing differences associated with three variations of the mnemonic strategy.

Magnitude of the Keyword Effect

The results of the study support the contention that the prose-learning strategy based on the keyword method, which had proved beneficial with other types of materials (Levin et al., 1981; Shriberg et al., in press), would also be effective for the recall of potentially confusable prose materials. The keyword effect in the present study, however, was not as large as had been demonstrated in previous studies. See Table 8 for keyword effect size measures, in terms of standard deviation units, for the present study as well as for the previous prose-learning studies. As can be noted in Table 8, the size of the keyword effect in the Keyword-Integrated condition, which is most similar to the typical Keyword Imagery condition, was quite a bit smaller than the average size of the keyword effect in the imagery conditions in the other studies

Table 8

Magnitude of the Keyword Effect in the Present Study as well as in Previous Studies

		Condition	Size of the Keyword Effect (in terms of S.D. units)
McCormick (1981)			
		Keyword-Paired (Structured Imagery)	0.53
		Keyword-Chained (Structured Imagery)	0.59
		Keyword-Integrated (Structured Imagery)	0.71
Shriberg et al. (in press)			
	Exp. 1	Keyword (Picture)	3.14
		Keyword (Imagery)	1.32
	Exp. 2	Keyword (Picture)	3.07
		Keyword (Imagery)	1.74
	Exp. 3	Keyword (Imagery)	1.81
Levin et al. (1981)			
		Keyword - 2 items (Picture)	1.64*
		Keyword - 4 items (Picture)	1.34*
Previous Keyword Studies			
		Average Keyword Effect Size (Picture) = 2.30*	
		Average Keyword Effect Size (Imagery) = 1.62*	

*Constrained by ceiling effect in keyword condition

(0.71 versus 1.62). Some plausible explanations for the relatively smaller keyword effect found in this study can be suggested.

First of all, in the interest of economy and greater ecological validity, the keyword instruction was administered in groups rather than in the more carefully monitored individual instruction sessions used in studies that have found very large keyword effects. Although in the recent study by Levin et al. (1981) relatively large keyword effects were produced by group instruction in the prose-learning version of the keyword method, a crucial difference between the Levin et al. (1981) study and the present one leads to the second plausible explanation for the smaller keyword effects found in this study--the type of keyword strategy introduced. That is, in the Levin et al. study (1981), keyword students were provided with complete interactive pictures whereas, although detailed "structured imagery instructions" were provided in this study, the keyword students were left to construct their own images. Typically, provided pictures produce larger keyword effects than imagery instructions (Pressley & Levin, 1978; Shriberg et al., in press). Evidence for this contention can also be noted in Table 8 in which it is shown that the average keyword effect, in terms of standard deviation units, is 2.30 when pictures are provided versus 1.62 when imagery instructions are given.

Another plausible explanation for the smaller keyword effects found in this study lies in the differences described previously between the "integrated" condition of this study and the one that

proved to be so facilitative in other studies (Levin et al., 1981; Shriberg et al., in press). Although the instructions for the Keyword-Integrated condition were similar to the typical "integrated" keyword condition, these imagery instructions were novel in that the keyword referent was not truly integrated with referents for the other pieces of information. Instead, the image produced by the Keyword-Integrated instructions was best described as a single sequential episode initiating from the keyword referent. The instructions were constructed in this fashion mainly because of the structured imagery format as well as due to the constraints imposed by the sequential presentation (sentence by sentence) of each passage. The sequential presentation was necessitated by experimental design (group instruction) and control (equivalent exposure to materials) considerations. Therefore, this integrated condition has the most to gain from the use of imposed pictures (rather than imagery instructions) and from simultaneous (rather than sequential) presentation of the text passage. In fact, it is rather remarkable that the Keyword-Integrated condition functioned as well as it did in this study, given that it is a simultaneous organizational strategy, and the procedures in this study were structured in exactly the opposite fashion (i.e., in favor of sequential "pairing" and "chaining").

The difference in subject populations used in the previous studies investigating the prose learning version of the keyword method and that used in this study, may be another reason for the moderate

size of the keyword effect in this study. The subjects used in the Shriberg et al. (in press) and Levin et al. (1981) studies were from schools serving a university community, whereas the subjects in this study, although of similar ages and from the same midwestern city, were from schools serving children from relatively lower socioeconomic families. Moreover, the experimenters who were involved in one or more of the other prose-learning keyword studies informally noted that in some of the classrooms inlcuded in this study, the students were considerably less attentive and cooperative than the students who participated in the other prose-learning studies.

Furthermore, the size of the keyword effect may have been reduced due to the lack of distinct cues in the to-be-recalled information. That is, some categories of information could have been difficult to distinguish from one another. The passages were constructed so as to maximize confusability between stories. Unfortunately, some within-story confusion may have inadvertently been created because of the inclusion of three closely related categories of information--(1) How did _____ earn extra money?, (2) What did _____ do for a living?, and (3) What did _____ do in his/her spare time?. The responses for these three categories could be readily interchanged. In fact, it was previously shown that in comparison to control students a higher proportion of the overt errors committed by the keyword students were within-story intrusions. This within-passage confusion may result from problems in decoding images in the cognitive cuing structures. Once a visual representation is recalled, it would also be necessary to be able to select the portion of the image that corresponds to the answer appropriate for the question at hand. This problem could be alleviated--and, therefore, the size of the keyword effect could be increased--by

employing a multiple-choice test as the dependent measure. Another technique to reduce within-passage confusion would require repeated exposures to the experimental materials until the structure of the materials is overlearned. It might also be anticipated that the ability of students to select the appropriate information from this overlearned structure, in both the random and ordered presentation conditions, would vary with age.

Finally, with the relatively liberal amounts of retrieval time used in this study, the recall differences may be more restricted to pattern than to amount of recall. With less retrieval time, the amount of recall may be more affected and, possibly, the keyword-control differences would increase. Of course, the opposite result is also possible.

Differences in Recall Patterns

Although all three variations of keyword instruction resulted in higher levels of recall in comparison to the control subjects, keyword subjects could also be distinguished from the controls, as well as from one another, on the basis of differences in their patterns of recall (i.e., the nature and organization of responses).

The likelihood of correctly recalling pieces of information that had been contiguously presented within a passage was found to vary as a function of instructional condition and question order. In the ordered question condition, it was found that students in the Keyword-Integrated and Keyword-Chained conditions were more likely to recall contiguous pieces of information than control students or those in the Keyword-Paired condition. Thus, all three keyword groups exhibited the same level of recall, but

the pattern of recall in the Keyword-Paired condition could be distinguished from that of the other two conditions. This lack of sequential dependency in the recall pattern of the students in the Keyword-Paired condition provides support for the description of the cognitive cuing structure produced by these instructions as "separate pairs". Likewise, the recall dependencies exhibited in the Keyword-Chained and Keyword-Integrated conditions provide support for cognitive cuing structures that are described as being "connected" in some fashion--either as a series of overlapping images or as a single interactive image.

When the data in the random question order are considered, the students in the Keyword-Integrated condition again were more likely to recall pieces of information that had been contiguously presented within a passage. In this question condition, however, the pattern of recall exhibited in the Keyword-Chained condition could not be distinguished from that of the controls and the Keyword-Paired condition. Thus, when the organization of the questions does not correspond to the organization of the hypothesized cognitive cuing structure, only the more "wholistic" connected cuing structure (i.e., Keyword-Integrated) results in recall dependencies.

Furthermore, it was determined that the experimental groups differed in terms of the kinds of errors made. This effect was also moderated by question order. Specifically, when the questions were organized in a fashion not conducive for making same-story intrusions (ordered question condition), it was found that in comparison to control students, only students in the Keyword-

Integrated condition were more likely to commit within-passage intrusions. On the other hand, when the questions were presented in an order in which same-story intrusions were more reasonable (random question condition), it was found that for all keyword versus control comparisons, a relatively greater proportion of the overt errors committed by the keyword groups were within-passage intrusions. Moreover, the keyword groups, once again, could be distinguished from one another on the basis of this overt error analysis. The "wholistic" keyword group (Keyword-Integrated) exhibited a significantly greater proportion of within-passage intrusions than the other two keyword groups, which did not differ in terms of level of same-story intrusions.

Suggestions for Future Research

Investigating processing differences. The short-answer questions used in this study limited the ability to discuss patterns of recall in comparison to data that would have possibly been produced by a free-recall measure. Therefore, it would be interesting to conduct a followup study in which students would be asked simply to recall as much of the passage information as they could. Then, the data could be analyzed to determine whether or not the various keyword groups differ in terms of amount recalled, as well as in terms of overt errors, in a non-cued testing situation. In addition, the extent to which clustering of related information is exhibited in the free recall protocols could be determined.

Furthermore, processing differences associated with the various keyword conditions could be further investigated using

a short-answer test in conjunction with the measurement of response latencies. This would be best accomplished in individual administrations with imposed pictures developed for the keyword variations used in the present study. In this case, however, the Keyword-Integrated condition would be structured so that the term "integrated" truly applies. This study would possibly be conducted with a smaller number of longer passages in which sources of within-passage confusability have been eliminated.

It would be anticipated that in the Keyword-Paired condition, the presentation order of the information within each passage would not affect the time required to make a correct response. This prediction is based on the nature ("separate pairs") of the hypothesized cognitive cuing structure in this condition. Likewise, for the Keyword-Integrated condition, the "wholistic" nature of the hypothesized cognitive cuing structure would suggest that little or no difference in response latencies, as a function of information position, would be detected. However, due to the "overlapping" nature of the cognitive cuing structure hypothesized for the Keyword-Chained condition (i.e., the need to recall the previous piece of information), it would be expected that, apart from serial position effects, students in this condition would take longer to respond to questions asking for information that had been presented at the end of the passage.

Prose interference effects. As stated previously, it was somewhat surprising that the keyword effects found in this study were not as large as had been demonstrated in previous studies--especially since it had been suggested that potentially confusable materials would prove to be a particularly fertile testing ground for the prose-learning version of the keyword method. Therefore, it would be interesting to conduct a study that directly addresses the prose interference question. First of all, it would be necessary to demonstrate that interference effects do result when materials very similar to those developed for this study are presented and studied successively. This could be accomplished by designating a target passage and determining the relative effect upon target passage recall of studying unrelated, interpolated passages, instead of the kind of interpolated passages that were used here. Once the presence of interference effects has been demonstrated with these materials, then it could be determined whether instruction in the most powerful variation of the prose-learning keyword method (i.e., the Keyword-Integrated) would help overcome the deleterious effects of interference. Followup studies could then be conducted to determine the relative effectiveness of other variations of the keyword method in eliminating interference effects. Furthermore, the prose-learning keyword method could be compared with other proven methods of eliminating interference effects

(Sulin & Dooling, 1974). Other variables, such as the number of pieces of information per passage, the number of interpolated passages, and the length of the retention interval could also be varied in order to determine possible limitations in the effectiveness of the keyword method in combating prose interference effects.

Educational Significance of the Study

The results of this study suggest that the keyword method is a potentially valuable instructional technique for the facilitation of the recall of factual information presented in prose materials. Furthermore, knowledge of the economical feasibility and ecological validity of the prose-learning version of the keyword method has been enhanced by the following results of this study.

First, group instruction in the keyword method, via written directions in booklet form, proved beneficial in this study. Although these group instruction keyword effects were not as large as those that have been demonstrated in individual instructional sessions (e.g., Shriberg et al., in press), the results of this study and the other group-administered prose-learning keyword study (Levin et al., 1981) are extremely encouraging for the educational practitioner. The success of group instruction in the prose-learning version of the keyword method is especially heartening in view of an on-going series of experiments (Levin et al., 1979; Levin, 1981) in which group instruction in the vocabulary-learning version of the keyword method has not resulted in improved

vocabulary recall among high school students. The question remains as to whether group instruction in the prose-learning version of the keyword method would facilitate students' recall of prose information with students of that age. Nonetheless, in terms of the generalizability of these results to other subject populations, it was gratifying that group instruction in the prose-learning version of the keyword method proved facilitative even in classrooms where students were not only from relatively lower socioeconomic areas but were also less cooperative and attentive than in previous keyword studies. Finally, in terms of the economical feasibility of the prose-learning version of the keyword method, it is important to note that expensive-to-produce pictures need not be provided since the "structured imagery instructions" used in this study proved to be facilitative. It would be interesting to see if verbal keyword (sentence or story) instructions, without the imagery component, would also prove effective. Likewise, the effectiveness of group instruction in the keyword method, when students are to generate keywords and images completely on their own, should also be determined. Of course, it is highly probable that these variations in the keyword method would not result in maximal levels of performance.

Still, it is important to consider some additional questions about the educational significance of the keyword method. Keyword strategy "maintenance" or the continued, unprompted application of

the strategy to new items from the same task for which the strategy was initially presented, should be investigated. The issue of strategy maintenance has been examined in some recent studies investigating the learning of social studies curricula under keyword strategy instruction (Jones & Hall, in press; Levin et al., 1980). Only Jones and Hall (in press), in a study in which eighth graders were taught a keyword strategy, provided some evidence of keyword strategy maintenance. In the Levin et al. (1980) study, elementary school children did not maintain use of the keyword strategy. Similarly, the "transfer" of keyword strategy usage to other tasks should also receive further empirical examination (see Pressley & Dennis-Rounds, 1980).

Finally, even though many of the keyword studies report very large treatment effects on immediate recall tests, little research has been conducted investigating the duration of these effects. Clearly, the ecological validity of the keyword method cannot be ascertained until more is known about whether or not the keyword effect is still present after the passage of time.

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Appendix A

Experimental Materials for all Conditions

Nature of Structured Imagery in the Various Keyword Conditions

	Sentence	Keyword-Paired	Keyword-Chained	Keyword-Integrated
			Condition	
			"Make up a picture in your head of:"	
1.	"Born and raised on a farm, David Zebrun has always been used to hard work."	a ZEBRA running out of a barn on a farm	a ZEBRA running out of a barn on a farm	a ZEBRA running out of a barn on a farm
2.	"While in high school, Zebrun spent a lot of time babysitting on weekends in order to earn spending money."	a ZEBRA with screaming babies riding on its back	babies playing in a barn on a farm	a ZEBRA running out of a barn on a farm with screaming babies riding on its back
3.	"Once he finished school, David Zebrun wanted a profession requiring a great deal of responsibility, and so he became a firefighter."	a firefighter spraying a firehose at a ZEBRA	a firefighter showing a firehose to some babies	a ZEBRA running out of a barn on a farm with screaming babies riding on its back toward a firefighter who is spraying his firehose

	Sentence	Condition: Keyword-Paired	Keyword-Chained	Keyword-Integrated
		"Make up a picture in your head of:"		
4.	"On his days off, there is nothing Zebrun likes better to do than to go bowling."	a ZEBRA kicking down bowling pins	a firefighter spraying a firehose at some bowling pins	a ZEBRA running out of a barn on a farm with screaming babies riding on its back toward a firefighter who is spraying his firehose at some bowling pins
5.	"One of Zebrun's long range goals is to eventually write a best-selling novel."	a ZEBRA turning the pages of a best-selling novel with its nose	a best-selling novel knocking down some bowling pins	a ZEBRA running out of a barn on a farm with screaming babies riding on its back toward a firefighter who is spraying his firehose at some bowling pins as he reads a best-selling novel

Nature of Structured Imagery in the Various Keyword Conditions

Sentence	Condition: Keyword-Paired	Keyword-Chained	Keyword-Integrated
	"Make up a picture in your head of:"		
1. "Douglas Fawcett is accustomed to the hustle and bustle of big city life, because his early years were spent living in a large apartment building in a crowded metropolitan area.	a huge water FAUCET in the doorway of an apartment building	a huge water FAUCET in the doorway of an apartment building	a second story window of an apartment building propped open by a huge water FAUCET
2. "In order to earn extra money, Fawcett worked after school selling tickets at a nearby movie theatre."	a huge FAUCET dripping tickets from a booth	a ticket booth in the doorway of an apartment building	a second story window of an apartment building propped open by a huge water FAUCET dropping tickets
3. "Upon his graduation from high school, Fawcett decided to join the military and began his career by enlisting as a soldier in the army."	a soldier turning a huge FAUCET	a soldier selling tickets in a booth	a second story window of an apartment building propped open by a huge water FAUCET dropping tickets to a soldier below

Sentence	Condition: Keyword-Paired	Keyword-Chained	Keyword-Integrated
	"Make up a picture in your head of:"		
4. "When Fawcett is on leave he likes to spend his time fishing."	a fishing pole hooked onto a huge FAUCET	a soldier carrying a fishing pole	a second story window of an apartment building propped open by a huge water FAUCET dropping tickets to a soldier below who is carrying a fishing pole
5. "Douglas Fawcett's favorite fantasy is imagining what it would be like to travel around the world in a hot air balloon."	a huge FAUCET dangling from a hot air balloon	a fishing pole dangling from a hot air balloon	a second story window of an apartment building propped open by a huge water FAUCET dropping tickets to a soldier below who is carrying a fishing pole that is hooked onto a hot-air balloon

Nature of Structured Imagery in the Various Keyword Conditions

Sentence	Condition: Keyword-Paired	Keyword-Chained	Keyword-Integrated
	"Make up a picture in your head of:"		
1. "Terry Nicholson's family was very wealthy, and she spent her early years living in a mansion."	the front steps of a mansion covered with a huge pile of NICKELS	NICKELS pouring out of an open door of a mansion	the front steps of a mansion covered with a huge pile of NICKELS
2. "Not long after she started going to school, Nicholson began to earn her own money by mowing lawns."	a lawnmower chewing up a pile of NICKELS lying in the grass	a lawnmower cutting grass in front of a mansion	the front steps of a mansion covered with a huge pile of NICKELS being chewed up by a lawnmower
3. "Nicholson had always been intrigued by the law and after years of effort she was finally elected a judge."	a judge in his robes tossing NICKELS	a judge in his robes cutting grass with a lawnmower	the front steps of a mansion covered with a huge pile of NICKELS being chewed up by a lawnmower pushed by a judge in his robes

		Condition		
	Sentence	Keyword-Paired	Keyword-Chained	Keyword-Integrated
		"Make up a picture in your head of:"		
4.	"Terry Nicholson's favorite pastime is making pieces of pottery for herself and for her friends."	a piece of pottery filled with NICKELS	a judge in his robes making a piece of pottery	the front steps of a mansion covered with a huge pile of NICKELS being chewed up by a lawnmower pushed by a judge in his robes as he holds up a piece of pottery
5.	"One of Nicholson's biggest dreams is that she'll some day be able to go to the moon."	a pile of NICKELS on the moon	a piece of pottery in the shape of the moon	the front steps of a mansion covered with a huge pile of NICKELS being chewed up by a lawnmower pushed by a judge in his robes as he holds up a piece of pottery that is shaped like the moon

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Nature of Structured Imagery in the Various Keyword Conditions

Sentence	Keyword-Paired	Keyword-Chained	Keyword-Integrated
		Condition	
		"Make up a picture in your head of:"	
1. "While Charlene McKune was growing up, she and her family led an interesting life traveling on their houseboat."	a RACCOON standing on the deck of a houseboat	a RACCOON standing on the deck of a houseboat	a RACCOON standing on the deck of a houseboat
2. "During her school years, McKune earned extra money delivering newspapers."	a RACCOON throwing newspapers onto a doorstep	newspapers being thrown to the shore from the deck of a houseboat	a RACCOON standing on the deck of a houseboat throwing newspapers
3. "McKune was always interested in whatever was happening around her, and so she eventually became a TV news reporter."	a RACCOON being interviewed by a TV reporter	a TV reporter throwing newspapers onto a doorstep	a RACCOON standing on the deck of a houseboat throwing newspapers to a TV reporter on shore

Sentence	Condition: Keyword-Paired	Keyword-Chained	Keyword-Integrated
	"Make up a picture in your head of:"		
4. "In her spare time, McKune loves to paint."	a RACCOON painting a picture	a TV reporter painting a picture	a RACCOON standing on the deck of a houseboat throwing newspapers to a TV reporter on shore who is painting a picture
5. "Although McKune is not particularly athletic, she still dreams of some day winning an Olympic gold medal."	a RACCOON with an Olympic gold medal around its neck	an Olympic gold medal hung on a painting	a RACCOON standing on the deck of a houseboat throwing newspapers to a TV reporter on shore who is painting a picture of an Olympic gold medal

Nature of Study Instructions for Control Conditions

Sentence	Condition	
	Simple Control	Cumulative Control
	"Try hard to remember that:"	
1. "Born and raised on a farm, David Zebrun has always been used to hard work."	ZEBRUN lived on a farm	ZEBRUN lived on a farm
2. "While in high school, Zebrun spent a lot of time babysitting on weekends in order to earn spending money."	ZEBRUN babysat	ZEBRUN lived on a farm babysat
3. "Once he finished school, David Zebrun wanted a profession requiring a great deal of responsibility, and so he became a firefighter."	ZEBRUN became a firefighter	ZEBRUN lived on a farm babysat became a firefighter

Sentence	Condition: Simple Control	Condition: Cumulative Control
	"Try hard to remember that:"	
4. "On his days off, there is nothing Zebrun likes better to do than to go bowling."	ZEBRUN enjoys bowling	ZEBRUN lived on a farm babysat became a firefighter enjoys bowling
5. "One of Zebrun's long range goals is to eventually write a best-selling novel."	ZEBRUN would like to write a best-selling novel	ZEBRUN lived on a farm babysat became a firefighter enjoys bowling would like to write a best-selling novel

Nature of Study Instructions for Control Conditions

Sentence	Condition: Simple Control	Condition: Cumulative Control
	"Try hard to remember that:"	
1. "Douglas Fawcett is accustomed to the hustle and bustle of big city life, because his early years were spent living in a large apartment building in a crowded metropolitan area."	FAWCETT lived in an apartment building	FAWCETT lived in an apartment building
2. "In order to earn extra money, Fawcett worked after school selling tickets at a nearby movie theatre."	FAWCETT sold movie tickets	FAWCETT lived in an apartment building sold movie tickets
3. "Upon his graduation from high school, Fawcett decided to join the military and began his career by enlisting as a soldier in the army."	FAWCETT became a soldier	FAWCETT lived in an apartment building sold movie tickets became a soldier

Sentence	Condition: Simple Control	Condition: Cumulative Control
	"Try hard to remember that:"	
4. "When Fawcett is on leave he likes to spend his time fishing."	FAWCETT enjoys fishing	FAWCETT lived in an apartment building sold movie tickets became a soldier enjoys fishing
5. "Douglas Fawcett's favorite fantasy is imagining what it would be like to travel around the world in a hot air balloon."	FAWCETT would like to travel in a hot air balloon	FAWCETT lived in an apartment building sold movie tickets became a soldier enjoys fishing would like to travel in a hot air balloon

Nature of Study Instructions for Control Conditions

Sentence	Condition: Simple Control	Condition: Cumulative Control
	"Try hard to remember that:"	
1. "Terry Nicholson's family was very wealthy, and she spent her early years living in a mansion."	NICHOLSON lived in a mansion	NICHOLSON lived in a mansion
2. "Not long after she started going to school, Nicholson began to earn her own money by mowing lawns."	NICHOLSON mowed lawns	NICHOLSON lived in a mansion mowed lawns
3. "Nicholson had always been intrigued by the law and after years of effort she was finally elected a judge."	NICHOLSON became a judge	NICHOLSON lived in a mansion mowed lawns became a judge

Sentence	Condition: Simple Control	Condition: Cumulative Control
	"Try hard to remember that:"	
4. "Terry Nicholson's favorite pastime is making pieces of pottery for herself and for her friends."	NICHOLSON enjoys making pottery	NICHOLSON lived in a mansion mowed lawns became a judge enjoys making pottery
5. "One of Nicholson's biggest dreams is that she'll some day be able to go to the moon."	NICHOLSON would like to go to the moon	NICHOLSON lived in a mansion mowed lawns became a judge enjoys making pottery would like to go to the moon

Nature of Study Instructions for Control Conditions

Sentence	Condition: Simple Control	Condition: Cumulative Control
	"Try hard to remember that:"	
1. "While Charlene McKune was growing up, she and her family led an interesting life traveling on their houseboat."	McKune lived on a houseboat	McKUNE lived on a houseboat
2. "During her school years, McKune earned extra money delivering newspapers."	McKune delivered newspapers	McKUNE lived on a houseboat delivered newspapers
3. "McKune was always interested in whatever was happening around her, and so she eventually became a TV news reporter."	McKune became a TV reporter	McKUNE lived on a houseboat delivered newspapers became a TV reporter

Sentence	Condition: Simple Control	Condition: Cumulative Control
	"Try hard to remember that:"	
4. "In her spare time, McKune loves to paint."	McKune enjoys painting	McKUNE lived on a houseboat delivered newspapers became a TV reporter enjoys painting
5. "Although McKune is not particularly athletic, she still dreams of someday winning an Olympic gold medal."	McKune would like to win an Olympic gold medal	McKUNE lived on a houseboat delivered newspapers became a TV reporter enjoys painting would like to win an Olympic gold medal

Appendix B

Instructions for all Conditions

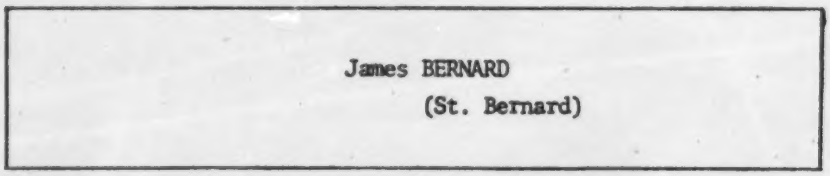
Keyword-Paired Instructions

You have just been told that you will be reading several stories about make believe people and important information about their lives. To give you an idea of the kind of stories you will be reading, take a look at the following story about someone named James Bernard.

> James Bernard's life has been a series of ups and downs--mostly downs. When he was a young man, he fell in a freak accident and broke both legs. Not too long after that his house was completely destroyed by a tornado. Just recently Bernard began to hope that his luck had finally changed when he won a 10-speed bicycle in a raffle.

It may be hard to remember this information about James Bernard when you will also be trying to remember information about several other people. So, in your study booklet, you will be shown a special way to help you remember the important parts of each person's life.

The first step of this special way to remember is to learn what we call a "word clue" for the last name of the person you will be learning about. A word clue is a word that sounds something like the person's last name but that is much easier to picture. For example, St. Bernard, like the dog, is a good word clue for James Bernard's last name. Before each story in the study booklet is read aloud, you will have a chance to learn the "word clue" for each person's last name. You will be given some time to study the person's name and word clue printed on a booklet page like this:



Turn to next page →

Then, after you follow along in the study booklet as each sentence of the stories is read aloud, you will be asked to make up a picture in your head of the word clue "doing something" to help you remember each important part of the person's life.

For example, after this sentence on a study booklet page is read aloud:

> When James Bernard was a young man, he fell in a freak accident and broke both legs.

You will be asked to turn to the next page in the study booklet and will be given some time to follow the directions for making up a picture in your head printed there. The picture will always hook the word clue onto the main information in the sentence. For this example, the directions might be:

> *Make up a picture in your head of:
>
> a St. Bernard with broken legs in casts

Were you able to do that?

The picture you make up in your head might have looked something like this:

Turn to next page →

Then, after the sentence on the next booklet page is read aloud:

> Not too long after that, Bernard's house was completely destroyed by a tornado.

You will be asked to turn to the next page of the study booklet and again given some time to make up a picture in which the word clue is hooked onto the main information in the sentence. For example:

> *Make up a picture in your head of:
>
> a St. Bernard looking over his shoulder at a tornado

Turn to next page →

Were you able to do that?

The picture you made up in your head might have looked something like this:

Then, after the sentence on the next booklet page is read aloud:

> Just recently Bernard began to hope that his luck had finally changed when he won a 10-speed bicycle in a raffle.

Turn to next page →

You will be asked to turn to the next page of the study booklet and given some time to read to yourself and follow the directions to hook the word clue onto the new information. For example:

> *Make up a picture in your head of:
> a St. Bernard riding a bicycle

Were you able to do that?

After the stories about four make believe people have been read (and you have made up pictures in your head as directed), you will be given a chance to answer some questions about each person. The pictures you made up in your head should help you to answer these questions.

For example, suppose you were asked:

> What happened to James BERNARD'S house?
> _____

The name BERNARD would make you think of the word clue St. Bernard which, in turn, would help you remember the picture you made up in your head of a St. Bernard looking over his shoulder at a tornado. So, the answer to the question is that James Bernard's house was destroyed by a tornado. This was just an example, and you won't be asked any more questions about James Bernard.

Turn to next page →

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From now on, the whole class will be reading the stories together. Before you hear about each person, you will be given a chance to learn the word clue for the person's last name. Then, after each sentence of the story is read aloud, you will be given time to follow the directions on the next page for making up a picture to help you remember the information in the sentence. After all the sentences have been read, you will be asked questions about each person. Use the pictures you made up in your head to help you answer the questions. If you have <u>any</u> questions, please raise your hand now and someone will come to your seat.

Keyword-Chained Instructions

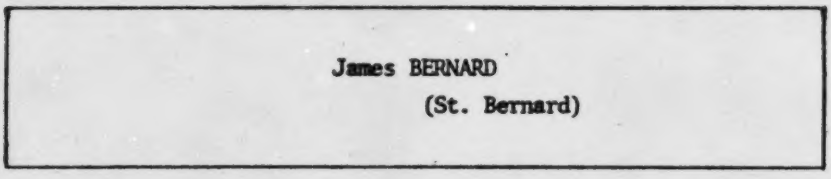
C1

You have just been told that you will be reading several stories about make believe people and important information about their lives. To give you an idea of the kind of stories you will be reading, take a look at the following story about someone named James Bernard.

> James Bernard's life has been a series of ups and downs--mostly downs. When he was a young man, he fell in a freak accident and broke both legs. Not too long after that his house was completely destroyed by a tornado. Just recently Bernard began to hope that his luck had finally changed when he won a 10-speed bicycle in a raffle.

It may be hard to remember this information about James Bernard when you will also be trying to remember information about several other people. So, in your study booklet, you will be shown a special way to help you remember the important parts of each person's life.

The first step of this special way to remember is to learn what we call a "word clue" for the last name of the person you will be learning about. A word clue is a word that sounds something like the person's last name but that is much easier to picture. For example, St. Bernard, like the dog, is a good word clue for James Bernard's last name. Before each story in the study booklet is read aloud, you will have a chance to learn the "word clue" for each person's last name. You will be given some time to study the person's name and word clue printed on a booklet page like this:



Turn to next page →

Then, after you follow along in the study booklet as each sentence of the stories is read aloud, you will be asked to make up a picture in your head of the word clue "doing something" to help you remember each important part of the person's life.

For example, after this sentence on a study booklet page is read aloud:

> When James Bernard was a young man, he fell in a freak accident and broke both legs.

You will be asked to turn to the next page in the study booklet and will be given some time to follow the directions for making up a picture in your head printed there. For the first sentence, the picture will always hook the word clue onto the main information in the sentence. For this example, the directions might be:

> *Make up a picture in your head of:
>
> a St. Bernard with broken legs in casts

Were you able to do that:

The picture you made up in your head might have looked something like this:

Turn to next page →

Then, after the sentence on the next booklet page is read aloud:

> Not too long after that, Bernard's house was completely destroyed by a tornado.

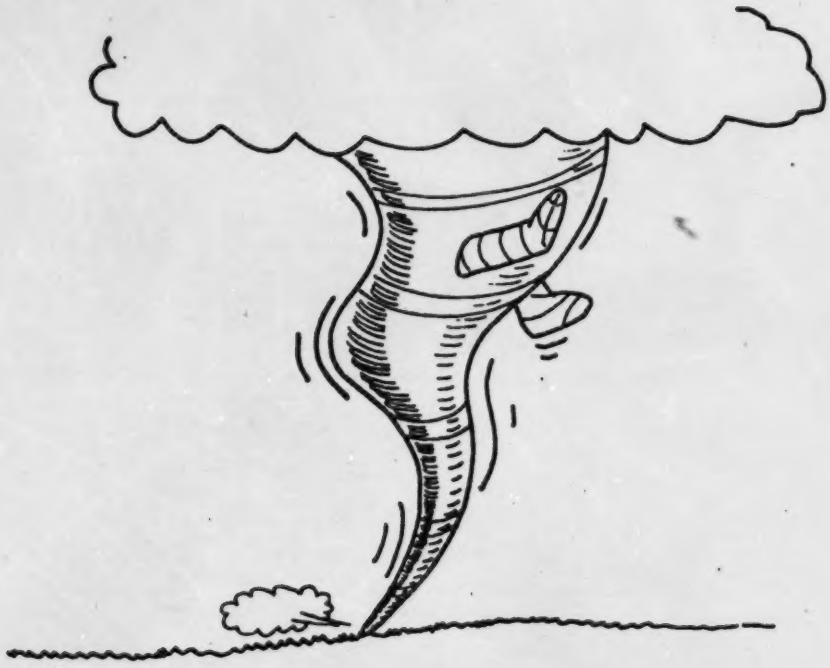
You will be asked to turn to the next page of the study booklet and given some time to make up a new picture in which the main information of the first sentence is hooked onto the new information. For example:

> "Make up a picture in your head of:
>
> broken legs, in casts, poking out of the top of the tornado

Were you able to do that?

The picture you made up in your head might have looked something like this:

Turn to next page →



Then, after the sentence on the next booklet page is read aloud:

> Just recently Bernard began to hope that his luck had finally changed when he won a 10-speed bicycle in a raffle.

You will be asked to turn to the next page of the study booklet and given some time to read to yourself and follow the directions to hook the main information of the last sentence onto the new information. For example:

Turn to next page →

*Make up a picture in your head of: a tornado chasing after someone riding a bicycle

Were you able to do that?

After the stories about four make believe people have been read (and you have made up pictures in your head as directed), you will be given a chance to answer some questions about each person. The pictures you made up in your head should help you to answer these questions.

For example, suppose you were asked:

What happened to James BERNARD'S house? _____

The name BERNARD would make you think of the word clue St. Bernard which would help you remember the picture you made up in your head of a St. Bernard with broken legs and the broken legs would, in turn, help you remember the picture of the casts sticking out of a tornado. So, the answer to the question is that James Bernard's house was destroyed by a tornado. This was just an example, and you won't be asked any more questions about James Bernard.

From now on, the whole class will be reading the stories together. Before you hear about each person, you will be given a chance to learn the word clue for the person's last name. Then, after each sentence of the story is read aloud, you will be given time to follow the directions on the

Turn to next page →

next page for making up a picture to help you remember the information in the sentence. After all the sentences have been read, you will be asked questions about each person. Use the pictures you made up in your head to help you answer the questions. If you have <u>any</u> questions, please raise your hand and someone will come to your seat.

Keyword-Integrated Instructions

You have just been told that you will be reading several stories about make believe poeple and important information about their lives. To give you an idea of the kind of stories you will be reading, take a look at the following story about someone named James Bernard.

> James Bernard's life has been a series of ups and downs--mostly downs. When he was a young man, he fell in a freak accident and broke both legs. Not too long after that his house was completely destroyed by a tornado. Just recently Bernard began to hope his luck had finally changed when he won a 10-speed bicycle in a raffle.

It may be hard to remember this information about James Bernard when you will also be trying to remember information about several other people. So, in your study booklet, you will be shown a special way to help you remember the important parts of each person's life.

The first step of this special way to remember is to learn what we call a "word clue" for the last name of the person you will be learning about. A word clue is a word that sounds something like the person's last name but that is much easier to picture. For example, St. Bernard, like the dog, is a good word clue for James Bernard's last name. Before each story in the study booklet is read aloud, you will have a chance to learn the "word clue" for each person's last name. You will be given some time to study the person's name and word clue printed on a booklet page like this:

James BERNARD (St. Bernard)

Turn to next page →

Then, after you follow along in the study booklet as each sentence of the stories is read aloud, you will be asked to make up a picture in your head of the word clue "doing something" to help you remember each important part of the person's life.

For example, after this sentence on a study booklet page is read aloud:

> When James Bernard was a young man, he fell in a freak accident and broke both legs.

You will be asked to turn to the next page in the study booklet and will be given some time to follow the directions for making up a picture in your head printed there. For the first sentence, the picture will always hook the word clue to the main information in the sentence. For this example, the directions might be:

> *Make up a picture in your head of:
>
> a St. Bernard with broken legs in casts

Were you able to do that?

The picture you made up in your head might have looked something like this:

Turn to next page →

Then, after the sentence on the next booklet page is read aloud:

> Not too long after that, Bernard's house was completely destroyed by a tornado.

You will be asked to turn to the next page of the study booklet and given some time to add to your picture in your head by hooking the new information onto the other information already in the picture. For this example, the directions might be:

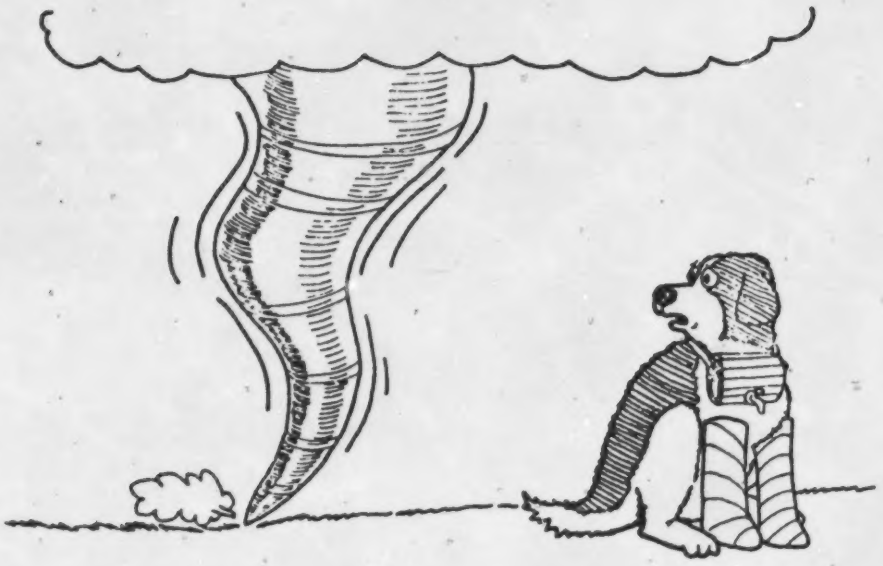
> *Make up a picture in your head of:
>
> a St. Bernard with broken legs in casts looking over his shoulder at a tornado

Were you able to do that?

The picture you now have in your head might have looked something like this:

Turn to next page →

I4



Then, after the sentence on the next booklet page is read aloud:

> Just recently Bernard began to hope that his luck had finally changed when he won a 10-speed bicycle in a raffle.

You will be asked to turn to the next page of the study booklet and given some time to read to yourself and follow the directions to hook the main information of the last sentence onto the picture already in your head. For example:

> *Make up a picture in your head of:
>
> a St. Bernard with broken legs in casts looking over his shoulder at a tornado and hopping on a bicycle

Turn to next page →

Were you able to do that?

After the stories about four make believe people have been read (and you have made up pictures in your head as directed), you will be given a chance to answer some questions about each person. The pictures you made up in your head should help you to answer these questions.

For example, suppose you were asked:

What happened to James BERNARD'S house?
_____

The name BERNARD would make you think of the word clue St. Bernard which, in turn, would help you remember the picture you made up in your head of a St. Bernard with broken legs looking over his shoulder at a tornado. So, the answer to the question is that James Bernard's house was destroyed by a tornado. This was just an example, and you won't be asked any more questions about James Bernard.

From now on, the whole class will be reading the stories together. Before you hear about each person, you will be given a chance to learn the word clue for the person's last name. Then, after each sentence of the story is read aloud, you will be given time to follow the directions on the next page for making up a picture to help you remember the information in the sentence. After all the sentences have been read, you will be asked questions about each person. Use the pictures you made up in your head to help you answer the questions. If you have any questions, please raise your hand now and someone will come to your seat.

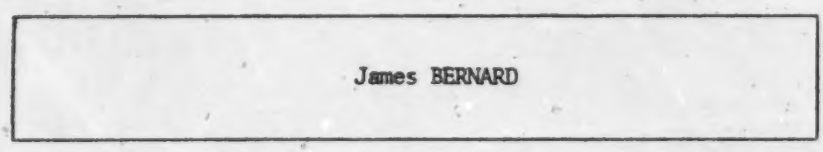
Simple Control Instructions

You have just been told that you will be reading several stories about make believe people and important information about their lives. To give you an idea of the kind of stories you will be reading, take a look at the following story about someone named James Bernard.

> James Bernard's life has been a series of ups and downs--mostly downs. When he was a young man, he fell in a freak accident and broke both legs. Not too long after that his house was completely destroyed by a tornado. Just recently Bernard began to hope that his luck had finally changed when he won a 10-speed bicycle in a raffle.

It may be hard to remember this information about James Bernard when you will also be trying to remember information about several other people. So, in your study booklet, you will be given a separate listing of the important information and will be told to try hard to remember these important parts of each person's life.

The first step to help you remember the important information is to become familiar with the person's name. Before each story in the study booklet is read aloud, you will have a chance to learn each person's last name. You will be given some time to study the person's name printed on a booklet page like this:



Then, after you follow along in the study booklet as each sentence of the stories is read aloud, you will be asked to try hard and use your own best method of studying to help you remember each important part of the person's life.

Turn to next page →

For example, after this sentence on a study booklet page is read aloud:

> When James Bernard was a young man, he fell in a freak accident and broke both legs.

You will be asked to turn to the next page in the study booklet and will be given some time to try hard to remember the main information from the sentence printed there like this:

> *Try hard to remember that:
>
> James BERNARD broke his legs

Were you able to use your own best method of studying to remember that information?

Then, after the sentence on the next booklet page is read aloud:

> Not too long after that, Bernard's house was completely destroyed by a tornado.

You will be asked to turn to the next page of the study booklet and given some time to study the new information printed there:

> *Try hard to remember that:
>
> James BERNARD lost his house in a tornado

Turn to next page →

Were you able to do that?

Then, after the sentence on the next booklet page is read aloud:

> Just recently, Bernard began to hope that his luck had finally changed when he won a 10-speed bicycle in a raffle.

You will be asked to turn to the next page of the study booklet and given some time to read to yourself and follow the directions to try hard to remember the main information from the sentence. For example:

> *Try hard to remember that:
>
> James BERNARD won a bicycle

Were you able to do that?

After the stories about four make believe people have been read (and you have tried hard to remember the information), you will be given a chance to answer some questions about each person. Whatever you did to study the information should help you to answer these questions.

For example, suppose you were asked:

> What happened to James BERNARD'S house?
>
> _____

Turn to next page →

Whatever you did to study the information should help you remember that the answer to the question is that James BERNARD'S house was destroyed by a tornado. This was just an example, and you won't be asked any more questions about James Bernard.

From now on, the whole class will be reading the stories together. Before you hear about each person, you will be given a chance to learn the person's last name. Then, after each sentence is read aloud, you will be given time to follow the directions on the next page to try hard to remember the information listed there. If you have any questions, please raise you hand and someone will come to your seat.

Cumulative Control Instructions

You have just been told that you will be reading several stories about make believe people and important information about their lives. To give you an idea of the kind of stories you will be reading, take a look at the following story about someone named James Bernard.

> James Bernard's life has been a series of ups and downs--mostly downs. When he was a young man, he fell in a freak accident and broke both legs. Not too long after that his house was completely destroyed by a tornado. Just recently Bernard began to hope that his luck had finally changed when he won a 10-speed bicycle in a raffle.

It may be hard to remember this information about James Bernard when you will also be trying to remember information about several other people. So, in your study booklet, you will be given a separate listing of the important information and will be told to try hard to remember these important parts of each person's life.

The first step to help you remember the important information is to become familiar with the person's name. Before each story in the study booklet is read aloud, you will have a chance to learn each person's last name. You will be given some time to study the person's name printed on a booklet page like this:

James BERNARD

Then, after you follow along in the study booklet as each sentence of the stories is read aloud, you will be asked to try hard and use your own best method of studying to help you remember each important part of the person's life.

Turn to next page →

For example, after this sentence on a study booklet page is read aloud:

> When James Bernard was a young man, he fell in a freak accident and broke both legs.

You will be asked to turn to the next page in the study booklet and will be given some time to try hard to remember the main information from the first sentence printed there like this:

> *Try hard to remember that:
>
> James BERNARD broke his legs

Were you able to use your own best method of studying to remember that information?

Then, after the sentence on the next booklet page is read aloud:

> Not too long after that, Bernard's house was completely destroyed by a tornado.

You will be asked to turn to the next page of the study booklet and given some time to study the main information from both sentences printed there:

Turn to next page →

*Try hard to remember that:

James BERNARD broke his legs

lost his house in a tornado

Were you able to do that?

Then, after the sentence on the next booklet page is read aloud:

Just recently, Bernard began to hope that his luck had finally changed when he won a 10-speed bicycle in a raffle.

You will be asked to turn to the next page of the study booklet and given some time to read to yourself and follow the directions to try hard to remember the main information from all the sentences. For example:

*Try hard to remember that:

James BERNARD broke his legs

lost his house in a tornado

won a bicycle

Were you able to do that?

After the stories about four make believe people have been read (and you have tried hard to remember the information), you will be given a chance to answer some questions about each person. Whatever you did to study the information should help you to answer these questions.

Turn to next page →

For example, suppose you were asked:

What happened to James BERNARD'S house?
_____

Whatever you did to study the information should help you remember that the answer to the question is that James BERNARD's house was destroyed by a tornado. This was just an example, and you won't be asked any more questions about James Bernard.

From now on, the whole class will be reading the stories together. Before you hear about each person, you will be given a chance to learn the person's last name. Then, after each sentence is read aloud, you will be given time to follow the directions on the next page to try hard to remember the information listed there. If you have any questions, please raise your hand and someone will come to your seat.

Appendix C

Raw Data for ali Conditions

Question Condition: Ordered

Treatment Condition: Keyword-Paired

Subject Number	Total Correct	Overt Errors			Omissions
		Same Story	Same Attribute	Other	
1	14	0	0	0	6
2	15	0	0	0	5
3	9	1	2	0	8
4	8	0	1	0	11
5	10	0	0	0	10
6	18	0	1	0	1
7	6	0	4	4	6
8	14	0	0	1	5
9	8	0	2	1	9
10	17	0	0	0	3
11	16.5	1	0	0	2
12	20	0	0	0	0
13	14	1	1	0	4
14	14	0	0	0	6
15	6	2	3	2	7
16	15	0	0	1	4
17	7	0	1	10	2
18	16	0	0	0	4
19	6	0	4	3	7
20	17	1	0	0	2
21	9	1	6	1	3
22	12	0	0	1	7

Question Condition: Ordered

Treatment Condition: Keyword-Chained

Subject Number	Total Correct	Overt Errors			Omissions
		Same Story	Same Attribute	Other	
23	15.5	0	0	0	4
24	13	0	1	0	6
25	10	0	5	0	5
26	16	0	0	1	3
27	16	0	1	0	3
28	20	0	0	0	0
29	20	0	0	0	0
30	20	0	0	0	0
31	16	0	2	0	2
32	13	0	0	0	7
33	14	0	2	0	4
34	11	2	1	1	5
35	16	0	1	0	3
36	18	0	1	0	1
37	6	1	5	0	8
38	11	1	0	0	8
39	8	0	8	0	4
40	4	1	8	1	6
41	12	0	3	0	5
42	10.5	0	1	1	7
43	5	1	0	4	10
44	20	0	0	0	0

Question Condition: Ordered

Treatment Condition: Keyword-Integrated

Subject Number	Total Correct	Overt Errors			Omissions
		Same Story	Same Attribute	Other	
45	16	0	0	0	4
46	18	0	1	0	1
47	20	0	0	0	0
48	12	0	4	0	4
49	16.5	1	0	1	1
50	11	0	3	1	5
51	20	0	0	0	0
52	16	0	1	0	3
53	15	2	0	0	3
54	7	2	2	4	5
55	14	0	3	0	3
56	5	0	3	1	11
57	20	0	0	0	0
58	11	1	0	6	2
59	11	0	2	0	7
60	18.5	0	0	1	0
61	5	5	6	1	3
62	7	0	2	4	7
63	18	0	1	1	0
64	19	1	0	0	0
65	8	1	2	0	9
66	18	0	0	1	1

Question Condition: Ordered

Treatment Condition: Simple Control

Subject Number	Total Correct	Overt Errors			Omissions
		Same Story	Same Attribute	Other	
67	1	0	9	0	10
68	12.5	0	2	0	5
69	6	0	5	1	8
70	12	0	2	0	6
71	11	0	6	3	0
72	17	0	2	0	1
73	10	1	5	0	4
74	15.5	0	0	0	4
75	16	0	0	0	4
76	17	0	2	0	1
77	1	0	2	0	17
78	7	0	4	1	8
79	5	0	8	5	2
80	13	0	4	0	3
81	9	1	3	0	7
82	16	0	3	0	1
83	16	0	0	3	1
84	8	0	7	1	4
85	12	0	2	0	6
86	7.5	1	0	2	9
87	13	0	2	0	5
88	7	0	5	0	8

Question Condition: Ordered

Treatment Condition: Cumulative Control

Subject Number	Total Correct	Overt Errors			Omissions
		Same Story	Same Attribute	Other	
89	8	0	5	0	7
90	3	0	6	0	11
91	8	0	2	0	10
92	5	1	7	1	6
93	15	0	4	1	0
94	17	0	1	0	2
95	4	0	6	9	1
96	20	0	0	0	0
97	17	0	1	0	2
98	4	1	8	6	1
99	11	0	2	2	5
100	2	0	2	0	16
101	10	0	6	0	4
102	7	0	4	0	9
103	8	0	6	1	5
104	15	0	2	2	1
105	1	0	0	0	19
106	13	0	3	0	4
107	6	0	5	2	7
108	10	0	4	6	0
109	12	0	1	1	6
110	10	0	0	4	6

Question Condition: Random

Treatment Condition: Keyword-Paired

Subject Number	Total Correct	Overt Errors			Omissions
		Same Story	Same Attribute	Other	
111	10	2	0	1	7
112	7	5	3	2	3
113	12	1	0	1	6
114	13	0	1	0	6
115	14	0	0	0	6
116	9	6	2	0	3
117	11	2	0	0	7
118	14	2	1	0	3
119	13	0	4	1	2
120	8	0	3	0	9
121	16	1	1	0	2
122	8	2	0	1	9
123	14	0	3	0	3
124	20	0	0	0	0
125	15	1	3	1	0
126	11	0	0	1	8
127	8	1	2	0	9
128	9	3	1	1	6
129	9	7	1	2	1
130	6	3	4	7	0
131	11	0	3	0	6
132	10	2	1	1	6

Question Condition: Random

Treatment Condition: Keyword-Chained

Subject Number	Total Correct	Overt Errors			Omissions
		Same Story	Same Attribute	Other	
133	9	4	0	2	5
134	13	0	3	0	4
135	8	3	3	0	6
136	14	1	2	1	2
137	16	0	1	0	3
138	14	1	3	1	1
139	8	2	3	0	7
140	15	4	0	1	0
141	9	4	0	0	7
142	12	1	4	0	3
143	8	2	1	0	9
144	9	0	3	0	8
145	3	1	3	1	12
146	9	1	3	0	7
147	7	0	6	0	7
148	20	0	0	0	0
149	16	0	3	0	1
150	11	1	6	0	2
151	9	4	2	1	4
152	6	2	0	1	11
153	16	2	0	0	2
154	6	6	3	3	2

Question Condition: Random

Treatment Condition: Keyword-Integrated

Subject Number	Total Correct	Overt Errors			Omissions
		Same Story	Same Attribute	Other	
155	13	7	0	0	0
156	5	3	0	2	10
157	19	0	0	0	1
158	14	2	0	0	4
159	8	1	1	0	10
160	10	1	4	1	4
161	12	6	0	1	1
162	20	0	0	0	0
163	7	6	3	2	2
164	12	7	0	0	1
165	19	1	0	0	0
166	11	6	0	0	3
167	18	1	0	0	1
168	11	3	4	2	0
169	10	4	3	0	3
170	10	2	3	1	4
171	8	1	5	0	6
172	18	2	0	0	0
173	19	0	1	0	0
174	16	0	1	0	3
175	11	3	0	3	3
176	11	8	1	0	0

Question Condition: Random

Treatment Condition: Simple Control

Subject Number	Total Correct	Overt Errors			Omissions
		Same Story	Same Attribute	Other	
177	4	1	5	0	10
178	5	1	6	1	7
179	5	0	9	0	6
180	13	0	4	0	3
181	9	1	4	3	3
182	3	1	8	0	8
183	7	0	5	2	6
184	19	0	0	0	1
185	3	1	4	1	11
186	7	2	4	3	4
187	13	0	5	1	1
188	4	0	5	4	7
189	6	0	9	5	0
190	10	2	6	0	2
191	8	2	4	2	4
192	11	1	3	1	4
193	2.5	2	4	4	7
194	6	0	5	0	9
195	3	2	3	0	12
196	20	0	0	0	0
197	7	1	1	2	9
198	11.5	0	4	0	4

Question Condition: Random

Treatment Condition: Cumulative Control

Subject Number	Total Correct	Overt Error			Omissions
		Same Story	Same Attribute	Other	
199	17	0	0	0	3
200	17	0	0	0	3
201	13	0	2	0	5
202	5	0	4	1	10
203	6	1	9	0	4
204	10	0	1	1	8
205	8	1	3	0	8
206	20	0	0	0	0
207	8	0	5	0	7
208	4	0	0	0	16
209	5	0	7	3	5
210	4	1	4	2	9
211	10	0	4	0	6
212	13	1	4	0	2
213	16	1	0	1	2
214	14	0	4	0	2
215	7	0	11	0	2
216	2	0	5	2	11
217	14	0	1	0	5
218	4	0	4	2	10
219	8	0	6	0	6
220	18	0	1	0	1